FORESTRY ABSTRACTS

IMPERIAL FORESTRY BUREAU

VOL. 5. No. 4. 1944

PUBLISHED BY THE IMPERIAL FORESTRY BUREAU, OXFORD

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FORESTRY ABSTRACTS

VOLUME 5 1944 NUMBER 4

TIMBER DECAY*[1]

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I. HISTORICAL INTRODUCTION.

KNOWLEDGE of the chemical and physical changes which occur during the decay of timber, and of the fungi which bring about these changes, has advanced rapidly during the past 15 years or so, the period covered by this survey.

Between the classical researches of R. Hartig, who discovered the true nature of decay in wood and described the role of fungi in causing tree diseases, and the intensive research work of the last few decades, there is a wide and rather sterile gap, during which individual workers in various countries made isolated investigations on specific problems. The monumental work of Falck (1907–27) on *Merulius lacrymans* and other fungi which cause dry rot in buildings is a landmark which leaves little more to be done on these particular organisms. The practical application of Falck's results was made available to the general public in this country by Groom (1927), who had made a special study of the German botanical literature and was well qualified to interpret it.

The study of timber decay arose as an offshoot from the study of tree diseases involving the trunk, and while there is, of course, no sharp dividing line between timber and forest pathology, in recent years some workers have tended to specialize and concern themselves rather more with the study of decay in felled timber. The establishment in various parts of the world of Forest Products Laboratories, i.e. institutes in which the properties and defects of timber as a material are studied from every angle, has led to a great development of research on timber decay, and it is largely as a result of their work that our knowledge of this subject has progressed so rapidly in recent years.

II. SILVICULTURAL CONSIDERATIONS.

It is beyond the scope of this article to consider in any detail the silvicultural conditions which lead to the development of decay in standing trees, but it is satisfactory to note that the importance of maintaining healthy growing conditions by correct silvicultural practice, thereby ensuring healthy trees with good quality timber, is being better appreciated by foresters.

The importance of felling a stand of trees as soon as the amount of rotting exceeds the rate of increment of the trees has been brought out in studies by Boyce (1932), who has shown that in certain stands of Douglas Fir the gross increment per acre keeps well ahead of the rot increment until an age of somewhere between 300 and 350 years is reached, when the latter equals it, and from then on exceeds it. It is not only in comparatively undeveloped countries, where virgin stands still exist which are becoming overmature, that this is of importance, for there are indications that butt rot of conifers in this country becomes significant under certain circumstances only when a certain age is reached. Generalizing, it may be said that crown rot of a tree becomes serious only as the trees become overmature, while butt rot is liable to attack comparatively young trees if the latter are growing under unfavourable conditions. Thus it is mainly with butt rot that the forester in this country is concerned. Day (1934) has quoted many examples of how an unsuitable environment affects the incidence of disease.

III. DIAGNOSIS OF CAUSE OF WOOD ROTS BY PURE CULTURAL METHODS.

The first problem which confronts the investigator of decay in timber is that of identifying the causal organism, especially when the rot is in an early stage. Hubert (1924) was one of the first to make a comparative study of the effects of various fungi on the microscopic appearance of the cell walls, and he published a useful table based on such characters as size of bore holes and presence or absence of clamp connexions on the hyphae in the wood. The examination of fungal mycelium in wood has been facilitated by the discovery of new techniques for staining and mounting of microscopic preparations. One of the simplest and most effective of these is the safranin and picro-aniline blue method described by Cartwright (1929). It is, however, only in a few species that the microscopic appearance of the mycelium and its effect on the wood are sufficiently characteristic to enable the organism to be identified, and in order to do so it is usually necessary to prepare cultures of the fungus. The majority of wood-rotting fungi do not fructify readily on ordinary media and it is necessary to have available for comparison either an extensive collection of named cultures, or accurate, well-illustrated descriptions of the cultures. The

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[1] Reproduced from *Biological Reviews*, 18, 1943 (145–58).

detailed and accurate descriptions of cultures of a number of important wood-rotting fungi in Canada published by Fritz (1923) provided an excellent basis for future work, and her paper is an important landmark in the study of wood-rotting fungi. In similar work along these lines Cartwright and Findlay (1930) have shown that it is possible to draw up diagnostic keys based on the cultural characteristics of the fungi. They also pointed out (1934) how certain physiological characteristics such as the optimum and maximum temperatures for growth and the rate of growth are useful aids in distinguishing between species in culture; for instance, the 'wild' species of *Merulius—M. sylvester*—is able to grow at 30° C. while the dry-rot fungus, *M. lacrymans*, does not grow at temperatures above 25° C. Humphrey and Siggers (1933) listed a large number of wood fungi according to their temperature relations. The chemical reactions induced by bacteria have long been recognized as useful criteria for their diagnosis, and this method has been used to some extent for characterizing fungi in culture; for instance, Bavendamm (1928) showed that the brown colour produced by a fungus when grown on a medium containing tannic or gallic acid indicates the presence of an oxidase, and that this enzyme is produced only by fungi which bring about white rots in wood (see p. 149). It may be noted here that the addition of a few drops of guaiacum solution to a liquid culture, giving a blue colour in the presence of oxidase, is an even more delicate test for distinguishing between cultures of fungi which cause brown rots and those which cause white rots.

The smell of certain cultures is highly characteristic, and Badcock (1939) has listed a number of species which can be recognized by the odours which they produce in culture. W. A. Campbell (1938) has pointed out how the different species of *Fomes* in culture produce distinct characters which make their identification fairly certain, and has drawn attention to the value of cultural studies not only for the diagnosis of the cause of decay but also in ordinary taxonomic work for distinguishing between species closely related in external form and for identifying abnormal or abortive forms of fungi. It is in ill-defined groups such as *Poria*, which possesses comparatively few morphological characteristics, that cultural studies are particularly useful, and Baxter, in a long series of papers, has made full use of cultures for characterizing the species of *Poria* which he has described. Refshauge and Proctor (1935) published a series of keys to certain wood-destroying fungi occurring in Australia, based on their appearance when grown on various agar media. While it may be possible to develop a reliable key so long as it is restricted to a certain group, the number of features available and subject to accurate description is limited, so that it is generally preferable to restrict any key of this kind to a group of fungi occurring on one host or on a series of related hosts. This method has been adopted by Cartwright and Findlay, who have given in keys and tabular form the diagnostic characters in culture of the fungi which cause rot in Oak (1936), in coniferous timbers (1938) and in other hardwoods (1942).

In the absence of a collection of standard cultures prepared from authentically named sporophores, the only means of recognizing the identity of an unknown species in culture is by its producing sporophores sufficiently typical to enable it to be recognized. A number of investigators have studied the conditions influencing their formation, and generalizing, it may be said that the following conditions must be fulfilled in varying degrees for each species: (1) a rich, well-aerated medium; (2) a relatively high moisture content around the growing mycelium; (3) an atmosphere of moderately high humidity, but not one saturated with moisture, around the developing sporophores; (4) exposure to light of an intensity and duration which is related to the natural habitat of the fungus.

Etter (1929) described a bread medium on which she found these fungi fructified readily, and recently Badcock (1941) has shown that sawdust with the addition of a small percentage of maize meal and bone flour provides an excellent medium for the cultivation of most wood-rotting fungi, and one on which sporophores are readily produced if other conditions are favourable.

IV. General Descriptive Work.

It is impossible within the scope of this article to refer to all the general descriptive work which has been carried out on the wood rots in the past few years; a great deal of this relates to heart rots of trees and is primarily of silvicultural interest. Much of this scattered information relating to decays of timbers used in this country has been brought together and critically reviewed in a series of papers by Cartwright and Findlay (1936, 1938, 1942). The heart rots of conifers in Norway have recently been fully described in a monograph by Jørstad and Juul (1939).

In America pioneer work in describing and classifying the commoner rots of timber was done by von Schrenk and Spaulding (1909), and since then the subject has been further extended by Humphrey, Snell, Hubert, Boyce, Zellner, Schmitz, Richards, Colley, and many others. Hubert (1931) and Boyce (1938) have both written text-books in which this accumulating knowledge has been sifted and critically summarized. In the nineteen-thirties an important series of papers on the heart rots in the forests of the Eastern U.S.A. appeared from the Bureau of Plant Industry in Washington under the names of Hartley, Davidson, Campbell and Blaisdell, and others. Their studies have been associated with forest improvement work by the Civilian Conservation Corps, and one of the interesting conclusions they have drawn from this work is that there is a very much greater risk of decay developing in trees grown from sprout shoots than there is in trees raised from seedlings. These workers have described a number of hitherto unrecognized rots and have extensively employed cultural methods for their recognition and characterization. Space does not permit the listing of many other important contributions to the study of forest and timber fungi which have been published by the Forest Experiment Stations and University Schools of Forestry in the U.S.A.

In Germany, Liese at Eberswalde, has investigated the butt rots of conifers and the so-called 'frost heart' in Beech, and has written extensively on many aspects of timber and forest pathology. In the last few years a number of lengthy papers which contain few original ideas have been published by a number of workers in Germany.

In a study of the fungi which rot railway sleepers in Poland, Walek Czernecka (1933) gave detailed and excellent comparative descriptions of the causal fungi and their microscopic characters. The fungi which grow on timber in damp mines have interested a number of mycologists on account of the curious abnormal forms which the

sporophores may assume under conditions of high humidity in the absence of light. Pilat (1927) has studied the flora of the Přibram mines in Czechoslovakia and described many 'forms' of the species which occur there.

Of the value of recent Russian work on this subject it is difficult for the authors of this review to judge, since these papers have been read only in summary or abstract form. Much, however, has been published, and Vanine (1930) has written a textbook on wood rot, describing the principal decays of timber in Russia. A considerable amount of systematic work on the taxonomy of the Polyporaceae has been carried out by Russian workers, which should help to clear up the unsatisfactory nomenclature of this group, which includes many species important as destroyers of wood.

Hemmi in Japan has done a good deal of descriptive work and (1932) published a longish paper on the fungi which attack conifers in Japan; a number of other Japanese workers have contributed to this subject.

Summing up, one may say that on the purely descriptive side great progress has been made during the last 10–15 years, and that the publication of handbooks and papers collating the results of different workers and listing descriptions in a comparative way with diagnostic keys has enhanced the value of a great deal of the descriptive work by individual workers.

V. Physiology of Wood-Rotting Fungi.

(1) *Effects of temperature relations.* It has already been indicated how the different cardinal temperatures for the growth of wood-rotting fungi may provide useful criteria for the recognition of certain species in culture. Lindgren (1933) has suggested that the optimum temperature for the growth of a fungus may be different on agar and in wood, but his data do not appear to be statistically significant. It has been found that the nature of the medium has, in general, little or no influence on the temperature relations of fungi.

In connexion with the sterilization of timber infected with decay, the thermal death point of various fungi has been determined. It has been found that the time required at various temperatures to kill most fungi varies considerably according to the physical condition of the medium in which the fungus is growing; generally speaking, the drier the medium the higher the temperatures or the longer the time required. Most of the tests have been carried out with agar cultures or with blocks of wood containing a high moisture content. Using infected blocks 1 inch cube of moist wood, Montgomery (1936) found that *Lentinus lepideus*, the most resistant of the fungi tested, was killed by an exposure for 60 min. to a temperature of 65° C. There seems to be a sudden increase between 60° and 65° C. in the effect of temperature on these fungi, so that much shorter times are required to sterilize wood at 65° than at 60° C.

Chidester (1937, 1939) carried out a series of tests in order to determine the length of time necessary to kill various fungi in wood, which were known to be resistant to heat. *Lenzites trabea*, *L. sepiaria* and *Lentinus lepideus* appeared to be most resistant of the fungi tested. She concluded that it is not practical to sterilize wood by using 'internal' temperatures lower than 150° F. (about 65° C.). Provided that the atmosphere around the wood was more or less saturated, so that little loss of water could take place, the following times and temperatures were found to sterilize the wood, even if it was infected with the most resistant of the fungi: 150° F. 75 min.; 170° F. 30 min.; 180° F. 20 min.; 200° F. 10 min.; 212° F. 5 min.

(2) *Nutritional requirements.* The nutritional requirements of wood-rotting fungi have been studied from two angles: (1) by pure culture studies; (2) by chemical analysis of the effect of the fungi on wood; this latter aspect is dealt with on p. 223.

It has been found that wood-rotting fungi can derive their energy from a wide range of polysaccharides. Glucose, as might be expected, is probably the sugar most favourable for their growth. Starch is readily attacked, as are many of the hemicellulose compounds. Some difficulty has been experienced in obtaining satisfactory growth on chemically prepared cellulose, although it is evident that this substance in the wood is readily attacked (see p. 223). Pentosans are also capable of acting as a source of energy.

The favourable effect on the growth of these fungi in wood of an increased content of nitrogen, particularly in an organic form in the wood, was demonstrated by Findlay (1934), and has since been confirmed by Schmitz and Kaufert (1936). The utilization of various nitrogen compounds was studied by La Fuze (1937), who found that some species utilize amino and ammonia nitrogen better than amide or nitrate nitrogen. The important discovery by Kögl and Fries (1937) that many Basidiomycetes are able to utilize inorganic forms of nitrogen only in the presence of aneurin (vitamin B_1), makes it necessary to reconsider in the light of this discovery much of the earlier work on the nitrogen metabolism of these fungi. Fries (1938) later extended the scope of these investigations and demonstrated the relation between various doses of aneurin and biotin and the response to this vitamin given by different fungi. He also showed that the presence of relatively small numbers of certain bacteria greatly stimulates the growth of some fungi in synthetic liquid media.

The specificity of many wood-rotting fungi *vis-à-vis* their hosts has long been a subject of enquiry. Some species, such as *Polystictus versicolor*, are able to grow on almost any kind of timber; others, particularly those which cause heart rots, are highly specific and grow on one species or genus of plants. Lutz (1925 *et seq.*), in a long series of papers, has shown that this specificity can be directly associated with the ability of the fungus to grow in the presence of certain toxic substances such as tannin, and that if samples of a timber such as Oak are thoroughly leached with water they become liable to attack by many other fungi (see p. 225). Although this conclusion appears generally to be true and it may be shown by experiment (Cartwright, 1937) that certain fungi such as *Fistulina hepatica*, which normally occurs only on Oak and Chestnut, can grow in a medium containing a comparatively high concentration of tannin, which inhibits the growth of most other fungi, yet many puzzling cases of specificity remain to be explained. Why, for instance, is *Polyporus betulinus* in nature almost completely confined to Birch, when it can be made to grow on a variety of woods in the laboratory? As far as is known, Birch does not contain a substance which is toxic to other fungi; it may be that Birch wood contains substances especially

favourable for the growth of *P. betulinus* or it may be that the physical conditions, such as the moisture and air relationships, in the Birch tree are peculiarly suited to this particular fungus; or again, it may be that it does in fact grow on other trees, but since the conditions there are unfavourable for the formation of its sporophores, it escapes detection. Further work on this interesting problem is required.

(3) *Hydrogen-ion concentration and growth.* It has long been known that most wood-rotting fungi render distinctly acid any medium in which they are growing and that they will make good growth only in a medium which is on the acid side of neutrality. These fungi vary considerably in the amounts of acid they produce; in general those which bring about a brown rot are capable of bringing the pH down to a lower figure than those which cause a white rot. The pH of an extract of wood decayed by *Merulius lacrymans* or *Coniophora cerebella* may be 3·0 or even lower, while that of wood severely rotted by *Polystictus versicolor* is usually about 4·5. In liquid media the acidity produced by brown rot fungi may persist for several months, but with white rot fungi, which possess an oxidase system, this initial increase in acidity soon tends to disappear, and the medium reverts to the initial pH, presumably as a result of the oxidation of the acids after depletion of the sugars; this reversal of pH change does not appear to take place when the fungi are growing in wood. Oxalic acid is probably the commonest organic acid produced by wood-rotting fungi, but Birkinshaw, Findlay and Webb (1940) have shown that *Coniophora cerebella*, when growing in Scots Pine sapwood, can produce considerable amounts of citric acid.

The spores of many Hymenomycetes require acid conditions in order to germinate, and some of the wood-rotting forms (e.g. *Merulius lacrymans*) require a strongly acid solution for the germination of their spores. It has been suggested by Curtin (1927 *et seq.*) that the production of acids by wood fungi may play an important part in rendering soluble and actively toxic, antiseptic substances, such as zinc meta arsenite, which have been deposited in an insoluble 'fixed' condition in the wood.

(4) *Growth in relation to moisture content of substratum.* It is extremely difficult to carry out carefully controlled experiments to determine the optimum moisture content for the growth of wood-rotting fungi, because these fungi by their action on the wood produce water of metabolism by breaking down the carbohydrates, and they thus raise the moisture content of the medium on which they are growing. Control of the atmospheric humidity around the test specimens is only effective when moisture contents below the fibre saturation point (about 27 per cent. of the dry weight in most woods) are required, and the optimum moisture content for the growth of most of these fungi lies considerably above this point.

For the general run of fungi moisture contents of between 35 and 50 per cent. (of the dry weight) are the most favourable for growth, though a few species, such as *Coniophora cerebella* and *Paxillus panuoides*, make better growth when the moisture content is higher still. The optimum moisture content for the growth of any particular fungus varies from one species of timber to another, depending on the density of the wood; in a dense timber a comparatively low moisture content may almost fill up the lumina of the cells and thus retard the growth of the fungus by reducing its oxygen supply, while in a very light, porous timber a very much higher moisture content still leaves sufficient space for the air necessary for the growth of the fungus. Thus there is a balance between the moisture and air requirements which varies from one specimen of timber to another, and it is not possible to lay down any exact optimum moisture content for any species of fungus except in relation to timbers of similar density and structure. For this reason experiments which have been carried out using sawdust instead of solid wood give results which are quite meaningless when applied to solid wood. On account of the much greater porosity of sawdust, the optimum moisture content for fungal growth in it is usually of the order of 200 per cent. of the dry weight.

It is possible to determine the minimum moisture for growth with somewhat greater accuracy than the optimum, but here again there is a complication, for the minimum moisture content at which spores may germinate and set up decay is somewhat higher than the minimum at which the fungal mycelium can infect a timber by growing on to it from an adjoining focus of infection. Practical tests in experimental floors have shown (Findlay, 1937) that there is no risk of *Merulius lacrymans* spreading to timber if its moisture content is below 20 per cent., and that there is very little chance of decay becoming initially established unless the moisture content is somewhat higher than this, e.g. probably round about the fibre saturation point.

Wood-rotting fungi are essentially aerobic organisms, and if wood is saturated with water there is no risk of its becoming decayed, although these fungi may remain alive for a considerable time under waterlogged conditions. The species of fungi vary considerably *inter se*, in their resistance to anaerobic conditions. *M. lacrymans*, for instance, is intolerant of waterlogged conditions and is never found growing in very wet wood; *Armillaria mellea*, on the other hand, can be observed on mine timbers which are saturated with water running over them; possibly the rhizomorphs of this latter fungus can enable a certain amount of air to reach the mycelium in the waterlogged areas.

(5) *Enzymes of wood-rotting fungi.* In comparison with the enzymes of other organisms those of the wood-rotting fungi have received but little systematic investigation and much of the information about them is of a very general nature. Most of the earlier workers were content to test an extract from the fungus against various substrata, and if decomposition of these substances was achieved the existence of a specific enzyme was assumed and an appropriate name was coined for the supposed enzyme. For instance, if lignin was found to be attacked the presence of a specific ligninase was presumed, in spite of the fact that all the analytical evidence has gone to show that decomposition of lignin by those fungi seems to be associated with intense oxidase activity (see p. 223)

Some of the difficulties experienced by the earlier investigators were probably due to the fact that they worked principally with extracts from the fruit bodies. It has since been shown that the enzymes in the sporophore are usually different in nature and present in smaller quantities than in the vegetative mycelium. Other workers used extracts from old cultures, in which enzyme activity had probably passed its peak.

Another obstacle to progress in the study of these enzymes has been the difficulty of obtaining the substrates

on which they are to be tested in a physico-chemical state similar to that in which they occur in the wood. Some forms of chemically prepared cellulose evidently differ considerably from the material which occurs in the tree, for fungi which grow readily on wood make but poor growth on filter-paper cellulose, even when the other necessary nutrients are added. The same is no doubt true to an even greater degree about the so-called 'pure' lignin which is extracted from wood. This appears to be highly resistant to decomposition by organisms which are known to be able to attack it when it is present in the naturally occurring ligno-cellulose complex.

Nutman (1929) examined the enzymes present in an extract from young, actively growing mycelium of *Polyporus hispidus*, and found evidence for the presence of emulsin, diastase, invertase, ligninase, hemi-cellulase, oxidase and catalase, but he himself did not consider this list to be exhaustive. Findlay (1932) found that hydrolyzing enzymes, but no evidence of oxidizing ones, were present in *Paxillus panuoides*. Montgomery (1936) examined the enzymes of *Fomes fraxineus* (which causes a white rot) and found oxidizing enzymes to be more abundant than those of a hydrolyzing nature.

The most recent and comprehensive study of the enzymes of wood-rotting fungi is that of Bose and Sarker (1937), who studied the activity of both the intracellular and extracellular enzymes in eight species of Polyporaceae at three different stages of their growth. They found that the amount of extracellular enzymes was in all cases much larger than that of the corresponding intracellular ones, indicating that the major portion of the enzymes formed in the cell is secreted externally into the medium. On *a priori* grounds this might have been expected, and it is somewhat remarkable that so little attention had been paid by previous workers to the enzymes secreted into the surrounding medium by the fungi. Bose and Sarkar reported that with the exception of catalase, the activity of all the enzymes tested was greater in mycelium in the vegetative state than in that which was fruiting or about to fruit. In addition to a number of enzymes capable of decomposing polysaccharides and lignin, they found small amounts of lipolytic and proteolytic enzymes. Of the Polypores which they tested, *Polyporus ostreiformis* was found to be the most active.

There is room for a great deal more research on the enzymes of wood-rotting fungi, both as to the nature of the enzymes and their mode of action, as well as on their occurrence in various fungi at different stages of their growth, and it is to be hoped that when this study is undertaken it will be carried out in conjunction with accurate micro-chemical investigations of the progressive decomposition of cell wall substance by the action of the fungi concerned.

(6) *Metabolic products of wood-rotting fungi.* The biochemical activities of some of the common moulds, e.g. *Aspergillus niger*, have been exhaustively studied, but until recently little attention has been paid to those of the higher fungi. The production of relatively large amounts of organic acids by some species has already been noted (p. 220). The ability of a Basidiomycete, *Schizophyllum commune*, to methylate sulphur with the production of methyl mercaptan has recently been demonstrated by Birkinshaw, Findlay and Webb (1942). It has long been suspected that wood-rotting fungi may be able to methylate arsenic with the production of volatile organic arsenical compounds in a manner similar to that of *Penicillium brevicaule*, for a garlic odour is produced when certain wood fungi are grown on a medium containing traces of arsenic, but so far such products have not in the case of the wood-rotting species been definitely identified.

Elementary analyses of the sporophores of many of the higher Basidiomycetes were carried out at an early date, and in Zellner's monograph (1907) there is an excellent survey of the work up to that time. Extracts from fruit bodies of the higher fungi have been used but little for pharmaceutical purposes, though *Fomes officinalis* (*F. laricis*), the quinine fungus, which contains a very high percentage of a bitter, resin-like substance, was formerly in considerable demand. So far the search for bacteriostatic substances does not appear to have revealed the presence of any suitable substances among the metabolic products of wood-rotting fungi.

VI. Physical Effects of Decay in Wood.

(1) *Effect on density.* Fungal decay soon brings about a reduction in the density of wood, and the percentage loss in dry weight brought about by a fungus is a useful measure by which the amount of decay which has taken place can be expressed quantitatively. This loss in weight is the result of the respiration of the fungus. The progressive loss in dry weight of samples of wood undergoing decomposition by a pure culture of a fungus has been followed by Findlay (1940*b*), who has shown that in the case of a fungus which causes a white rot in which all the constituents of the wood are attacked, this may proceed until the wood substance is totally consumed, but where the fungus is unable to decompose lignin and brings about a so-called brown rot, the maximum loss in weight which it can cause is about 70 per cent. of the original dry weight. Gaümann (1930) has shown that at least in the earlier stages of decay the fungus decomposes chemically more wood substance than it is able to utilize, so that strictly speaking the loss in weight does not give a complete measure of the total change brought about by the fungus: since, however, it bears a direct relation to the amount of true decomposition and is a quantity which can readily be determined, it is still generally used in experimental work instead of chemical analysis, to estimate the degree of decomposition brought about by fungi.

Once a piece of wood is permeated with mycelium, and until the constituents from which the fungus is deriving its nourishment become depleted, loss in weight bears a direct relation to time during which the fungus has been allowed to act, and a graph of loss in weight plotted against time of exposure is a straight line over the greater part of its length. Lightness in weight is often taken by practical inspectors of timber to indicate the presence of dote, but by itself it is an unreliable test, since abnormally light timber may be the result of growth conditions. Since, however, timber with a specific gravity abnormally low for the species is usually weak, its rejection may thus be justified.

(2) *Effect on mechanical properties.* It is, of course, a matter of common knowledge that decayed wood is softer and less strong than sound wood, but it is only in the last few years that accurate measurements have been made of the amount of depreciation in the strength properties at various stages of decay. Cartwright, Findlay

Chaplin and Campbell (1931) examined the strength of Sitka Spruce after various periods of exposure to *Trametes serialis* and showed that over 15 per cent. loss in strength as measured by equivalent fibre stress at maximum load occurred after only two weeks' exposure to fungus. At this stage the wood showed very little external sign of discoloration or other change, nor had an appreciable loss in dry weight occurred. Chemical analysis, however, showed that an increased percentage of the wood was soluble in dilute alkali, indicating that breakage had occurred in some of the cellulose chains. The progressive increase in the alkali solubility in the case of this brown rot could be very closely correlated with the falling away in mechanical strength. When the fungus brings about a white rot the alkali solubility does not afford any indication of the extent of the attack. Cartwright, Campbell and Armstrong (1936) investigated the effect of *Polyporus hispidus* on Ash wood, and they found that while the bending strength is slightly reduced in an early stage of fungal infection, it is the toughness or shock resistance which is most rapidly affected, a 20-per-cent. reduction in impact bending strength (toughness) being observed after only 2 weeks' exposure to fungus. After 12 weeks' exposure, the toughness of the wood had dropped to 10 per cent. of its original value, while over 90 per cent. of the original crushing strength remained. It is evident that this early reduction in bending strength must be due mainly to a shortening of the fibres in the wood. It was concluded that the loss in strength of Ash wood caused by *P. hispidus* is caused mainly by depletion and alteration of the cellulose and its associated pentosans.

Scheffer, Wilson, Luxford and Hartley (1941) have also investigated the effect of various fungi on the strength of Sitka Spruce. They found that in wood attacked by *P. schweinitzii* in which the specific gravity had been reduced by 10 per cent., the maximum crushing strength was down by 30 per cent. and the toughness was reduced by 95 per cent., while in wood severely rotted by *Fomes* (*Trametes*) *pini* in which the specific gravity had been reduced by 30 per cent., the reductions in crushing strength and toughness were 70 per cent. and 95 per cent. respectively, thus emphasizing how the different mechanical properties suffer different percentage reductions under the action of the same fungus. Scheffer (1936) carried out a comprehensive series of tests to determine the influence of *Polystictus versicolor* on the chemical and physical properties of the wood of *Liquidambar styraciflua*. Changes in the various properties of the wood were correlated wherever possible. He noted that the cell walls were uniformly thinned as a result of attack. He found that initially most of the strength properties were lowered in varying degree, more rapidly than the specific gravity, and that in the later stages of decay *all* the strength properties fell more rapidly than the specific gravity.

(3) *Effect of decay on moisture relations and calorific value.* It is a well-known fact that decayed wood absorbs liquid water and becomes waterlogged very much more rapidly than sound wood. Presumably the bore holes made by the fungal hyphae in the fibre walls permit the escape of the imprisoned air and the entry of the water. It has been noted (*Forest Products Research Annual Report*, 1935) that slight incipient decay by *Stereum sanguinolentum* greatly increases the penetration of creosote into Norway Spruce.

The influence of decay on moisture absorption and retention was also studied in the course of Scheffer's tests, and he found that 'decayed wood was somewhat more responsive to atmospheric moisture changes than the sound wood, decidedly more susceptible to changes in water in liquid form, and much more capable of maintaining a substantially higher moisture content when intermittently exposed to liquid water'. This means that once a piece of wood is affected with decay the moisture conditions in it will remain favourable for fungus growth over longer periods than in a piece of sound wood exposed to the same cycle of conditions. Scheffer (1936) also examined the loss in calorific value of the wood and found this to be directly proportional to the losses in wood substance which had occurred, there being no evidence of changes in the calorific value per unit weight of wood.

(4) *Effect on appearance and optical properties of wood.* Decay in wood is almost invariably accompanied by a change in colour: it may become bleached in the case of a white rot or darkened in the case of a brown rot. Scheffer (1936) has shown that the lightening in colour brought about in the early stages of attack by *Polystictus versicolor* is due to the destruction by the fungus of pigmented materials in the wood rather than to removal of lignin as was formerly believed.

The first effect of a white rot may be a darkening of the wood, e.g. the incipient stage of attack by *Stereum spadiceum* in Oak is the formation of brownish streaks, and it is only in later stages that pipes of whitish rot appear. It is probable that this initial darkening is due to the oxidation of tannins by the enzymes of the fungus.

In some instances discoloration of wood may be due to the production of definite colouring substances by fungi, for example, the vivid green colour brought about by *Chlorosplenium aeruginosum* has been shown to be due to the production by this fungus of a substance which has been named xylindein by Kögl and Tauffenbach (1925). Similarly, the rich brown colour of brown Oak is probably due to the production of a coloured product by *Fistulina hepatica* (Cartwright, 1937). The discoloration of wood which is commonly known as sap stain or blue stain is, on the other hand, due to the presence of dark-coloured hyphae of certain Ascomycetes (especially *Ophiostoma* spp.) in the cells of the wood and not to the secretion of any colouring matter by these fungi.

Lohwag (1937) has proposed the use of polarized light for the microscopic investigation of decayed wood, since cellulose is doubly refractive and visible between crossed nicols, while the anisotropic lignin and pectic substances are not. This method is probably of limited application, for the differences observed are conspicuous only in the later stages of attack.

Wood severely rotted by certain fungi, in particular by *Armillaria mellea*, may become strongly luminescent, but it is probable that this luminescence is emitted by the fungal hyphae and the wood substance itself is not actually rendered luminescent.

The change in the X-ray patterns obtained has been proposed by Schulze, Theden and Vaupel (1937) as a means by which the degradation of the cellulose in wood may be followed. In wood severely rotted by a brown rot the X-ray pattern of cellulose may entirely disappear after 6 months' exposure to fungal attack. X-ray photographs to detect areas of decay in poles have already been used under practical conditions.

VII. The Chemical Effects of Decay in Wood.

Decomposition of wood by fungi is of two types, which have been described as brown rots and white rots respectively. In brown rots the cellulose and its associated pentosans are attacked while the lignin is left in a more or less unchanged condition; in a 'white' rot all the components of the wood, including the lignin, are decomposed. Classification of decay types along these lines was suggested by Falck and Haag (1927), Wehmer (1927) and Bavendamm (1927), who proposed the terms 'destruction rot' and 'corrosion rot' for the two types, the former covering the 'brown rots' and the latter the 'white rots'. Most of the earlier workers carried out their analyses on samples of wood in which decay had reached a fairly advanced stage under natural conditions. In order to get an accurate picture of what is happening during the decay process, it is necessary to have available for comparison analyses of the original wood and to know how much wood substance has been lost during the progress of the decay: otherwise it is impossible to determine how much depletion each of the constituents has undergone. For instance, if a fungus utilizes all the constituents of the wood, it is possible that analysis, even of severely decayed wood, may reveal comparatively little change in the relative proportions of the components. Analytical results should, therefore, always be related to the original sound wood. Campbell and Booth (1929), working with Sitka Spruce sawdust undergoing decomposition by *Trametes serialis* in pure culture, were able to show that the brown rot caused by this fungus was very similar in its effect to that of mild acid hydrolysis. In this brown rot the cellulose and its associated polysaccharides were depleted, while the slight loss in lignin could be accounted for by the fall in the methoxyl content.

On account of the bleaching action of some of the white rot fungi it had long been assumed that they attacked mainly the lignin in the wood, but more recent work has shown that while the fungi which cause a 'white' rot do decompose lignin, other substances are attacked at the same time, and no wood-rotting fungus has been described as capable of deriving *all* its energy from the lignin in wood, and indeed it would be surprising if such should be found, for lignin is a stable and comparatively inert material which is resistant to decomposition. Lutz (1930) followed the degradation of Beech wood by *Polystictus versicolor* using micro-chemical staining methods for the recognition of the products of decay, and summed up the process as a typical hydrolysis, successively decomposing the lignin, the cellulose, and finally the middle lamella, the cell wall substance being degraded into insoluble gums, then to soluble gums, and finally to sugars, which constitute the source of carbon for the nutrition of the fungus. Campbell (1931, 1932) examined the chemical action on Beech wood of various other white rot fungi, and endeavoured to classify them into three groups, according to which constituents of the wood are attacked first. There is fairly good evidence for assuming that the intensity of the attack on the lignin is directly related to the oxidase activity of the fungus: for instance, an extract from the mycelium or culture fluid of *P. versicolor*, which can cause an active white rot, gives a very strong reaction when tested with guaiacum solution for the presence of oxidases. Bavendamm (1928) has described a test by which the presence of the oxidases characteristic of the fungi which cause white rots can be detected by growing the fungi on an agar medium containing tannin. If an oxidase is produced, a dark ring appears around the culture. The reaction of a large number of species of wood-rotting fungi has since been tested in this way by Davidson, Campbell and Blaisdell (1938). They found that 156 species, representing 96 per cent. of those associated with white rots, gave positive reactions, the intensity of the reaction showing considerable variation. A few of the fungi associated with brown carbonizing rots gave inconsistent results, but in most of those tested, no reaction was obtained on the gallic or tannic acid medium.

Campbell (1932) suggests that one of the principal chemical bases for differentiating between white and brown rots is the difference in the effect on the alkali solubility, which in the case of a brown rot steadily increases as decay progresses, and is roughly proportional to the amount of cellulose depletion, while in a white rot it may arise slightly at first, but soon falls back to or below the original figure for sound wood. Wiertelak (1932) examined the effect of decay caused by *Trametes pini* and *Polystictus hirsutus* on sawdust of *Pinus taeda* and *Abies concolor*, and found that while in general the white rot results in a marked decrease of the lignin, a slow consumption of the cellulose goes on, preceded by its gradual chemical modification, *Polystictus hirsutus* being able to attack cellulose more rapidly than *Trametes pini*.

Scheffer (1936), in his comprehensive study of the effect of *Polystictus versicolor* on Red Gum sapwood, followed changes in its chemical composition as decay proceeded. He found that the relative proportions of the principal wood components were not materially altered. Based on the weight of the original sound wood, the lignin, pentosans not in the cellulose, cold-water-soluble and 1-per-cent. alkali-soluble components were first attacked, while the Cross and Bevan cellulose, pentosans in cellulose and strictly hot-water-soluble portions were little affected until part of the wood substance had been consumed. In the earlier stages of decay the depletion of cellulose was represented by losses in both the stable and unstable forms, while in later stages the consumption of stable cellulose was more pronounced.

The general mode of action of the two types of decay—the brown and the white rot—are thus now fairly clear, and a general picture of the process of fungal decay in wood can be built up, but as yet comparatively little information is available about the intermediate products formed during decomposition. The successive degradation of cellulose and of the other polysaccharides in the wood appears to begin with a shortening of the cellulose chains, and this, with increasing hydrolysis of the polysaccharides, leads to the breakdown of the condensation products of the various wood sugars with formation of the corresponding hexoses and pentoses, which at certain stages in decay are formed more rapidly than the fungus can utilize them, so that an extract from decayed wood shows strongly reducing properties when tested with Fehling's solution. Intensive research into the nature of the lignin complex is now being undertaken, and when the structure of this substance is better understood it will be possible to find out how closely the residual lignin left after fungal decay resembles the original material as it occurs in the cell walls of the wood.

By the use of microchemical methods, which will enable small samples to be examined, it should eventually be

possible to obtain fundamental information about the composition and arrangement of the principal cell-wall components by following the changes which take place as breakdown caused by fungal decay proceeds. In this connexion one may regard the enzymes of the fungus as mild chemical reagents which can be used under controlled conditions to bring about less drastic changes than those wrought by the reagents such as 72-per-cent. sulphuric acid, which are commonly used in wood analysis.

VIII. Effect of Fungal Decay on Microscopic Structure of Wood.

Reference has been made (p. 217) to the comparatively slight diagnostic value of the appearance of fungal hyphae in wood and to their effect on the cell walls. While wood-rotting fungi differ in the extent to which they penetrate the cell walls, their action within the two groups of the brown and the white rots appears in the main to be similar.

In wood attacked by a fungus which causes a brown rot, the cell wall does not appear to be thinned appreciably until a very late stage of decay, and even when practically all the cellulose lattice has been removed, the residual lignin preserves the form of the original cell walls. It is characteristic of most of the active brown rots that the hyphae which penetrate the walls form bore holes, which become appreciably wider than the diameter of the hypha. In white rots, on the other hand, a general thinning of the cell walls, in addition to the formation of bore holes, is a usual feature of the more advanced stage of decay. This is rather to be expected, since all the constituents of the wood are decomposed by white rot fungi. However, the residual cellulose left in wood attacked by white rot is sufficient, even in a quite advanced stage of rot (e.g. up to 70 per cent. loss in weight), to enable the wood to retain its shape and outward structure, whereas in a brown rot disintegration due to removal of cellulose begins to appear at a much earlier stage of decay. The penetration of membranes such as cell walls by fungal hyphae is a problem which has attracted the attention of a number of workers. Nutman (1929) described the penetration of the cell wall in Ash by hyphae of *Polyporus hispidus* as follows: a young hypha, so fine that it appears merely as a line of protoplasmic granules under $\frac{1}{19}$ in. objective, comes in contact with a wall. It bores straight through, usually at right angles to the wall, with no change of diameter. Nutman suggests that at this stage the penetration must be enzymatic, since it would appear difficult for so fine a thread with no appressorium to penetrate a thick lignified cell wall by mechanical means. After penetration the young hypha thickens until it reaches its mature size (i.e. in this case 1·5 μ), while the portion in the wall remains exceedingly fine. After this erosion starts from one end of the thin thread and is soon followed by erosion at the other end; this continues until two cone-shaped openings are formed with their axis along the hypha. As the cones increase in size the hypha swells up. Eventually with this species a large cylindrical or hour-glass-shaped bore hole, with a diameter several times that of the hypha, is formed, in which the hypha lies unconstricted. The amount of subsequent enlargement which takes place varies greatly from species to species, and with some fungi the bore holes remain small, with the hypha always showing a constriction where it passes through the cell wall.

Cartwright (1930), who studied the penetration of the cell walls in Spruce by the hyphae of *Trametes serialis*, observed that on approaching or on contact with a tracheid wall the contents of a small hypha become concentrated at the tip, from which a fine projection emerges; this develops into a fine thread, which on contact with the wall forms a V-shaped nick. He concluded that the actual penetration must be rapid, since it was extremely rare to find cases in which the hypha had penetrated only partly through a wall. He noted that with this species the bore holes continued to enlarge after the penetration of the wall and that sometimes it might reach a size several times greater than that of the hypha. He came to the conclusion that the cellulose in the cell wall must be altered chemically by the enzymes of the fungus prior to penetration of the wall by the hypha, which might then be at least partly mechanical. Proctor (1941) investigated the mode of penetration of cell walls of four different woods by six species of fungi. He used very high magnifications and took every precaution to obtain preparations showing undistorted hyphal penetrations. His visual observations were supplemented by excellent photomicrographs taken with ultra-violet light. A large number of bore holes were also examined under polarized light, but no interference patterns of any kind that might indicate the presence of mechanical failures were observed. He finally concludes that penetration of the walls of wood cells is accomplished by (1) the secretion of enzymes at the tips of penetrating hyphae, and (2) the total local dissolution of the cell wall by enzymic activity in advance of actual passage through the wall. He thus postulates that penetration is effected through a preformed passage without actual contact between the hypha and the cell wall, except perhaps at the very first point of penetration, when a stimulus to initiate enzymic activity may be set up. He found no evidence for any existence of any mechanical forces being exerted during penetration. It may be noted in this connexion that the hyphae of sap-stain fungi, e.g. *Ophiostoma* spp., which penetrate the tracheid walls quite freely without any appreciable softening by chemical action having taken place previously, develop well-marked appressoria, so it is reasonable to imagine that the final stage of penetration by the hyphae of wood-rotting fungi through a wall already softened by enzyme action may involve some mechanical pressure, though the amount of force required may not be great enough to leave any evidence on the cell walls.

Tamblyn (1937) has described an unusual type of hyphal penetration in Jarrah (*Eucalyptus marginata*). In this wood affected with so-called black-straw rot (caused by a Basidiomycete fungus), large bore holes occur, which run for long distances down the secondary fibre walls *parallel to the long axis of the fibres*. These bore holes may be so numerous as to be almost contiguous in transverse section.

Bailey and Vestal (1937) have described peculiar cavities which are formed in the cell walls of a wide variety of trees by certain unidentified fungi, which are stated probably to be Pyrenomycetes. These cavities, which may be cylindrical or biconical in shape, are of remarkably constant angularity, regardless of the species of tree in which they occur, and in outline they recall the shape of certain crystals. Their formation suggests that hydrolysis of the cellulose through enzymatic activity proceeds along two clearly defined sets of planes: (1) those oriented parallel to

the long axis of the fibrils and chain molecules of cellulose, and (2) those at an angle of 20° to 25° to this axis. It is much to be hoped that it will be found possible to isolate and identify these fungi, since a detailed chemical and physical study of their action on the cell wall may elucidate many problems relating to its physico-chemical fine structure as well as to the mode of action of the specialized fungi concerned.

IX. Natural Durability and Resistance to Decay of Timbers.

Timbers vary enormously in their resistance to fungal decay; some, like Sycamore and Poplar, disintegrate rapidly after only a few months' exposure to fungal attack; others, such as Oak and Teak, will endure for very many years even when they are in contact with the soil and exposed to severe risk of fungal attack. Naturally the reasons for this difference have long been a subject of enquiry. Once a tree has been felled the heartwood in those species which show a well-defined heartwood is invariably more resistant to decay than the sapwood, and it was therefore concluded that it is the presence in the wood of those substances which are formed when the living cells in the sapwood lose their vitality and when heartwood formation takes place, that confers on it the resistance to fungal decay. In many species the amount of material which can be extracted by hot water is much higher in the heartwood than in the sapwood, and it was to these so-called extractives that attention was first directed. Hawley, Fleck and Richards (1924), who tested the toxicity to *Fomes annosus* of standard hot- and cold-water extracts prepared from a wide range of timbers, were able to show a close correlation between the toxicity of the extracts and the resistance to decay of the timbers from which they had been prepared; for instance, the hot-water extract from such durable timbers as Mulberry, Catalpa and Redwood (*Sequoia sempervirens*) entirely inhibited the growth of the test fungus. Anderson (1931) examined the toxicity of extracts of *Pinus ponderosa* to *Lenzites saepiaria*, but did not find the extract from the heartwood to be much more toxic than that from the sapwood. Anderson and Sherard (1933) described the isolation from *Thuja plicata* wood of an exceedingly toxic crystalline substance which they named dehydroperillic acid and for which a structural formula was proposed. Migita (1932) examined the resistance to decay of sawdust from four timbers after extraction with various solvents and concluded that the durability of *Thujopsis dolabrata* is due to the toxicity to fungi of its alcohol-benzene-soluble constituent (probably an ethereal oil), while that of *Castanea crenata* results from a similar property in its hot-water-soluble components. Ernest (1936) described a simple test by which she claimed it was possible to determine whether a timber contains a toxic substance soluble in water. One-half of a small petri dish is filled with damp sawdust of the timber under examination and the other half with nutrient agar which is infected with a transplant of the test fungus. If the sawdust contains a toxic material soluble in water, this will diffuse into the agar and check the growth of the test fungus.

The important role of tannins in conferring resistance to decay has been pointed out by Lutz (1928), who showed that a fungus such as *Polystictus versicolor*, which normally does not attack Oak heartwood, can be induced to do so if the wood is leached so as to remove the tannin. He considers that the tannin inhibits the oxidizing activity of the ferments produced by the fungus. It is noteworthy that those fungi which can attack Oak heartwood are able to grow in media containing relatively high concentrations of tannin (Bavendamm, 1928).

Resistance to decay cannot be related directly to density. Although in a general way it is true to say that most of the very dense woods are durable, yet some comparatively light woods, such as Western Red Cedar (*Thuja plicata*), are highly resistant to decay. It is probably true to say that in general the most durable timbers are those which have a high density combined with a high content of extractives toxic to fungi. There is a need for further research on the nature of the toxic extractives present in wood, and it has often been suggested that useful ideas for the development of new and more effective wood preservatives could be obtained were there a better understanding of the nature of the natural preservative material in durable woods.

The natural resistance to decay of timbers has been tested in the laboratory by a number of investigators, e.g. Humphrey (1915, 1916), Schmitz and Daniells (1921), Hubert (1929), Lutz (1935), Liese (1937), Findlay (1938). In general, the methods have involved the exposure of small sterilized samples of the timber to the attack of a number of test fungi growing in pure culture under controlled conditions of temperature, etc., and the amount of decay resulting from the fungal attack has been measured by estimating the loss in dry weight. The results of such tests have been found in general to agree quite well with the behaviour of the timbers in practice, and they are useful for enabling an opinion as to the probable durability of a new species to be given in a comparatively short time or for determining the susceptibility of some individual timber to a particular fungus, such as *Merulius lacrymans*. Field tests, usually known as 'graveyard' tests, have been carried out at a number of centres, and these are especially useful in tropical countries where resistance to termites is equally as important as resistance to fungi, for it is very difficult to carry out tests in the laboratory on the relative susceptibility of timbers to termite attack. Such 'graveyard' tests have recently been carried out by officers of the Forest Departments in many tropical countries, and progress reports on the results obtained have been published in the annual reports of the various Forest Departments concerned. Only rarely has any attempt been made to list the fungi which develop on the test pieces or to keep any account of the fungal flora which develops at various stages during the 'life' of the test sample. Such information would have considerable interest from an ecological point of view, for it is obvious that in nature a log of wood suffers attack from a definite succession of forms. Brooks, Adamson, Baker and Crowdy (1941) have listed the fungi which appeared on the test pieces in graveyard tests carried out in Trinidad, and it is to be hoped that similar information will become available from other localities.

Great variation in the resistance to decay occurs within the same species of timber. In coniferous timbers slow-grown timber from mature trees tends to be more resistant than wide-ringed material from young trees, but resistance to decay does not appear to be correlated with ring width or density to anything like the same extent as do the strength properties of the timber. Findlay (1940*a*) examined the resistance to decay of *Pinus sylvestris* from a number of different sources and found that Russian material was only slightly more resistant to decay than that

from more southerly countries. Cartwright (1941) has shown that considerable variation may exist within a single log of *Thuja plicata*, the most durable timber being that derived from the outer heartwood adjacent to the sapwood in the butt of the log. It is possible that the comparatively low resistance of the heartwood near the pith of the tree may be the reason why butt rot almost invariably makes its appearance at the centre of the trunk and slowly works its way outwards, but further tests with other species of trees will be necessary before this suggestion can be applied as an explanation of the form taken by butt rot of trees in general.

It is a well-established belief among timber merchants, that timber felled in the spring and summer is less resistant to decay than timber felled in autumn and winter. Gaümann (1930) carried out a large number of carefully controlled experiments in order to discover whether this belief has any foundation in fact. He concluded that while the external factors of climate and the greater intensity of infection in the summer account for much of the deterioration which occurs in summer-felled timber, yet there is in Spruce and Fir, while still in the green, unseasoned condition, an actual inherent difference in resistance to decay, the wood felled in the early summer being more rapidly decayed, under controlled conditions, by the test fungi which were used than wood felled in winter. These differences were more pronounced in the sapwood than in the heartwood, but nevertheless were shown to exist in the latter. He carried out an exhaustive series of analyses to determine the content of the various substances in the wood at different times of the year, but was unable to correlate the change in resistance to decay with any fluctuation in any of the major constituents of the wood, and in consequence he concluded that the reason for difference in resistance is to be found in variations in the physico-chemical structure of the cell wall at different seasons, rather than in alterations in the chemical composition of the wood. After seasoning for one year in the open, the difference in decay resistance between the summer- and the winter-felled timber was found to be very much less than that found when the timber was tested in the green condition, and this fact tends to support Gaümann's view that it is the physical condition of the colloids in the cell wall which is the factor responsible for the differences observed.

Since timber is not usually used until it has been seasoned, it would appear that there is very little risk in using summer-felled material, provided, of course, that it can be seasoned without serious degrade owing to cracking and blue-stain, both of which are more liable to occur under summer conditions than during the colder months of the year. Gaümann (1938) did not consider that there was any significant difference in rot resistance of Beech felled at different seasons. In view of the very pronounced views held by practical men on this subject, it would be of interest to investigate this problem further and to include tests on a range of species, both broadleaved and coniferous.

X. Preservation of Timber by Chemical Treatment.

While the technical aspects of timber preservation are outside the scope of this review, it may be of interest to describe briefly some of the progress that has been made in recent years.

Coal tar creosote has been found so effective a preservative for timber that it still holds the field after nearly a century of use, for the preservation of structural timber which is exposed to the weather or used in contact with the soil. A great deal of work has been carried out in order to determine the relative effectiveness of the various components of creosote oil, and recent research tends to show that the highly toxic tar acids do not play such an important part as they were at one time believed to do.

The use of water-soluble preservatives has tended to increase since the discovery that by the addition of chromate to solutions containing arsenic, zinc or mercury in a soluble form, these elements become 'fixed' or rendered insoluble in the wood after it has been impregnated, so that the treated wood can safely be used in situations where it may sometimes be exposed to the leaching action of rain. Many of the most successful mixtures of salts for the preservation of wood are based on variations of a mixture proposed by Malenkovic which included sodium fluoride and dinitrophenol or its sodium salt. The files of the Patent Offices contain endless descriptions of various preservatives made up of various combinations of salts toxic to fungi, but the vast majority of these have never been developed. In recent years a number of oil-soluble preservatives consisting of a toxic substance such as copper naphthenate or pentachlorphenol dissolved in white spirit has been put on the market. This type of preservative has certain advantages for the preservation of timber on which it is desired to apply subsequently some decorative finish and when any distortion of the ready-shaped timbers is undesirable, e.g. for the preservation of joinery, of the wooden parts of motor bodies, and of the wooden parts of boats such as yachts and lifeboats, etc.

The need was soon felt for some agreed method of testing wood preservatives in the laboratory, so that results obtained in one research institute could be directly compared with results obtained in other similar places. In the U.S.A. the so-called agar or Petri-dish method was used almost exclusively until a few years ago. By means of this method, which consists in determining the minimum quantity of the substance which incorporated into a nutrient agar medium prevents all growth of the test fungus thereon, it is possible to get repeatable results with some degree of accuracy. Most European workers have felt, however, that the physical conditions in an agar gel are so very different to those pertaining in wood that it is preferable to carry out tests with the substances impregnated into wood blocks which are subsequently exposed to fungal attack under controlled conditions. They have maintained that it is preferable from a practical point of view to get results which may be less precise, but which bear some relation to practical conditions. As a result of a conference held in Berlin in 1930, a standard method for carrying out tests to determine the toxicity to fungi of wood preservatives was described (Liese, Nowak, Peters and Rabanus, 1935). Since then a British Standard specification (1939) has been published which gives details of a standard test which follows the general lines of that proposed by the international committee.

So far only limited success has been obtained in efforts which have been made to correlate toxic activity with chemical structure, but a great deal of useful information on this subject has been accumulated during a series of investigations which were carried out at the Forest Products Laboratory in Madison, with the object of developing effective fungicides for the surface treatment of lumber against moulds.

XI. Field Studies of Timber Decay and the Application of the Results of Research to Practice.

Field studies of the occurrence and prevalence of various types of decay on timber in service have covered a wide range of localities in which timber is used. Dry rot in buildings has been studied in relation to the types of construction involved. Once the fundamental conditions for the growth of the causal organisms have been elucidated, application of this knowledge must be related to architectural design so that conditions suitable for fungus growth do not arise, or if they accidentally develop, the timber is protected against attack. When, for instance, it has been established that *Merulius lacrymans* cannot develop at a moisture content below 20 per cent. of the weight of the wood, then it becomes the duty of the architect or builder to design his buildings so that under no condition will the moisture content of timber in a building exceed this figure. If experience shows that there is inevitably a risk of woodwork remaining moist over any length of time, then preservative treatment must be applied before the timber is put into service. It is now common practice to creosote under pressure all railway sleepers and telegraph poles, but even to-day a great deal of untreated fencing is erected, only to decay a few years later. As in so many other fields of human activity, the development of fundamental knowledge has far outstripped the application of scientific research to practice. The decay of timber in mines is a striking example of the failure to apply to practice the results of research. Cheap methods for the preservation of mining timber have been known for half a century or more, yet until a few years ago replacement of the timbering along the permanent ways in some damp coal mines has had to be undertaken almost yearly as a result of fungal decay. In the last few years there has been a great development of timber preservation in the South African gold mines, and the operating companies now find it worth their while to maintain a special laboratory for the study of timber problems.

All too often in the past the liability to decay of timber has been accepted as an inevitable defect in this, the most useful of all constructional materials, and it is much to be hoped that in the future education of the prospective users of timber will enable them to utilize timber in such a way that subsequent losses through fungal decay are reduced to a minimum.

XII. Summary.

After a brief historical introduction, attention is drawn to the importance of the correct silvicultural management of woodlands in the production of clear, disease-free timber. Methods for the identification of the organisms which cause decay in timber are discussed, and the importance of pure culture methods is stressed. The principal contributions to the general descriptive work on timber decay in various countries are referred to, and it is pointed out how the usefulness of much of this work has been enhanced by the publication of books and monographs collating this scattered information. In a discussion of the physiology of wood-rotting fungi the temperature relations and nutritional requirements, growth in relation to pH, and moisture content of the substratum are considered. The unsatisfactory state of present-day knowledge of the enzymes of wood-decaying fungi is mentioned. Recent work on the metabolic products of wood-rotting fungi is referred to briefly. The effects of decay on the physical properties of wood are described, i.e. on the density, strength and optical properties, etc. The mechanical strength of timber, especially the toughness, may be appreciably affected in a very early stage of decay before any measurable loss in weight has occurred. The chemical changes brought about during the decomposition of wood are discussed. Rot of timber can be classified chemically into two main types: brown rots, in which only hydrolysis of cellulose and other polysaccharides occurs, and white rots, in which all the constituents of the wood, including the lignin, are attacked in varying degrees and in which oxidizing as well as hydrolyzing enzymes are present. The effect of fungal attack on the microscopic structure of wood is described, and the theories put forward to explain the penetration of the cell walls by hyphae are critically examined. Methods of determining the natural resistance to decay of timber in the laboratory are referred to, and the basis of natural durability in wood is shown to lie mainly in the nature of the chemical 'extractives' present in the wood. Recent advances are described in the use of water-soluble wood preservatives which become fixed in the wood by the addition of a chromate to the treating solution, and the establishment of a British Standard method of test and the use of field tests are noted. Finally, attention is drawn to the great lag in the application to practice of recent advances in the study of timber decay and its prevention.

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ABSTRACT SECTION

NOTE.—A capital letter in square brackets following the reference denotes the language in which the paper is written. A small letter denotes a summary in another or the same language, e.g. [G.e.]—German, with English summary. English [E.] is only indicated for papers published in journals usually written in foreign languages.

The term "billion" used in papers originating in North America means a thousand million.

0. GENERAL FORESTRY

01. NOMENCLATURE. BIBLIOGRAPHY. MATHEMATICAL AND STATISTICAL ANALYSIS

01.2 : 12.25–8. LITTLE, E. L. **Homonyms among names of trees and fossil plants.** *J. Wash. Acad. Sci.* 33, 1943 (130–5). L.S.

Attention is drawn to certain homonyms which were detected when the accepted names of native and naturalized trees of the United States were checked against names of fossil plants in the paleobotanical card catalogue of the United States Geological Survey, Washington, D.C. In the course of the preparation of a revised 'Check List of Native and Naturalized Trees of the United States', only three changes in nomenclature were necessary owing to the previous use of the names for fossil plants, but the names of several species of fossils were found to be preoccupied by recent trees. Names derived from large geographical areas and epithets of obvious descriptive character have a relatively high probability of being homonyms and should be checked with particular care. Taxonomists and paleobotanists are advised to compare, before publication, any proposed new names with the available indexes of living and fossil plants in order to avoid the use of names which are preoccupied.

01.2 : 12.25–8. NEWINS, H. S. **Some misnomers of shade trees and ornamentals.** *Proc. 5th Sth. Shade Tree Conf.* 1942 (241–53). [Univ. of Florida, Gainesville, Florida.]

The situation with regard to the nomenclature of United States trees is briefly reviewed, and a list is given of some commonly misapplied vernacular and trade names together with suggested corrections. The publication by the U.S. Forest Service in 1940 of 'Approved Changes in Sudworth's [1927] Check List' was one of the most important single contributions to standardized nomenclature. It included 720 official changes in accordance with the official code of 'Standardized Plant Names' first published in 1917, and was an important factor influencing the revised issue of this publication in 1942.

Five main innovations appear in the new revision. These are:—(1) Disuse of the capital initials for all species and botanical varieties. (2) Double 'ii' ending of species names changed to single 'i'. (3) Sign of possessive (') omitted. (4) One standard common name for each plant. (5) Consolidating compound names—elimination of hyphens.

Examples are given of some typical nomenclatural changes in the common names of American trees.

01.2 : 12.25–8 (71 : 73). Nomenclature des principaux arbres du Canada et des Etats-Unis. **[Nomenclature of the principal trees of Canada and the United States.]** Ministère des Terres et Forêts, Province de Quebec. 1943. pp. 9. [F.E.]

01.2 : 12.26–8 (68) : 12.19. KOTZE, J. J. **Nomenclature of the South African Yellowwoods. Introduction with notes on distribution.** *J. S. Afr. For. Ass.* No. 10, 1943 (23–5).

01.2 : 12.26–8 (68). SMITH, C. A. **[Nomenclature of the South African Yellowwoods.] Nomenclature of *Podocarpus* species.** *J. S. Afr. For. Ass.* No. 10, 1943 (26–8).

Following proposals for changing the botanical names of the South African species of Podocarpaceae, recommendations were made by the Union Forestry Department to the International Botanical Congress, held in Cambridge in 1930, for the conservation of the names then in use. The reasons for the rejection of these recommendations and the adoption of new names are discussed for each species in the second paper. The present botanical names for the four South African species, with the former names in brackets, are *Podocarpus latifolius* (Thunb.) R.Br. *ex* Mirb. [*P. thunbergii* Hook.], *P. elongatus* (Dryand.) L'Herit. *ex* Pers. [*P. thunbergii* var. *angustifolia* Sim.], *P. henkelii* Stapf. *ex* Dall. and Jacks. [*P. falcata* (*P. thunbergii* var. *falcata* Sim.)], *P. falcatus* (Thunb.) R. Br. *ex* Mirb. [*P. elongata* Carr. *p.p.* (*non* L'Herit. *ex* Pers.).]

Notes are given on the distribution of *P. elongatus* and on the reputed occurrence of *P. henkelii*, *P. gracilior* and *P. gracillimus* in the Transvaal.

01.6 (498). HABERLER, E. Schrifttumsnachweis über die rumänische Forstwirtschaft und deren Grundlagen. **[A bibliography of Rumanian forestry.]** *Suppl.* to *Cbl. gesamte Forstw.* 68, 1942. pp. 56. [G.]

01.6 : 33.0 : 38.1–2. **Lumber literature—a bibliography.** National Lumber Manufacturers Association, Washington, D.C. [1942?]. pp. 55.

01.7 : 52.43 : 57.0 : 56.02. DWIGHT, T. W. **The use of statistical methods in forestry.** *Engng. J., Montreal* 26, 1943 (400–1). [Univ. of Toronto.] L.S.

The author discusses briefly the use of statistical methods in forestry work, particularly in determining volume of standing timber and size and age-class distribution, in estimating future growth, and in sample-plot analysis.

02. DICTIONARIES

02.4 (71.4) : 01.2. HUDON, J. E. Dictionnaire de locutions et termes forestiers techniques. **[Dictionary of technical forest terms and expressions.]** *For. québec.* 1 (1–9), 1939 (1–72); 2 (1–10), 1940 (73–152); 3 (1–10), 1941 (153–232); 4 (1–10), 1942 (233–316); 5 (1–5), 1943 (317–352); 6 (1–3), 1943 (353–399).

04. MAPS. PHOTOGRAPHY

04.4 (47.1). LINNAMIES, O. **The use of forest maps for military purposes.** *Acta for. fenn.* 50 (9), 1942 (1–10). [Finn.g.] S.P.S.

The writer proposes that the maps of the state forests in northern and eastern Finland should be completed on scales of 1:20,000 and 1:100,000 for military purposes.

05. PERIODICALS

05.3. *Annual Reports*

05.3 (54 : 59.1) : 07.2. INDIA and BURMA. **Forest research in India and Burma, 1941–42. Part 1.—The Forest Research Institute.** Forest Research Institute, Dehra Dun. [1943?] pp. 151 + plates.

05.3 (68.1). BECHUANALAND. **Annual report of the Department of Forests, Bechuanaland Protectorate, for the year ended 31st December, 1941.** Department of Forests, Bechuanaland and Swaziland. [1942?] pp. [2].

05.3 (68.9) NORTHERN RHODESIA. **Department of Agriculture: annual report for the year 1942.** Govt. Printer, Lusaka. 1942. pp. 7.

05.3 (69). MAURITIUS. **Annual report of the Forest Department for the year 1942.** Govt. Printer, Port Louis, Mauritius. 1943. pp. 9.

05.3 (74.3). VERMONT. **Vermont Agricultural Experiment Station, Burlington, Vermont: Fifty-fifth annual report 1941–42.** *Bull. Vt. agric. Exp. Sta.* No. 495, 1942. pp. 37.

05.3 (76.4). TEXAS. **Texas Agricultural Experiment Station. Fifty-fourth annual report, 1941.** Agricultural and Mechanical College of Texas, College Station, Texas. [1942?]. pp. 202.

05.3 (77.2). INDIANA. **Fifty-fourth annual report of Purdue University Agricultural Experiment Station, Lafayette, Indiana, for the year ending June 30, 1941.** Purdue University Agricultural Experiment Station. [1941.] pp.114.

05.3 (94). AUSTRALIA. **Council for Scientific and Industrial Research. Division of Forest Products. Annual report, 1942–43.** [Melbourne, 1943?] pp. 17 + [3].

06. SOCIETIES. ASSOCIATIONS. CONVENTIONS. CONFERENCES

06.1 (485) : 60.31 : 94.12 : 23.3 : 11.49.5. LOTHIGIUS, W. Skogssällskapet 30 ar. **[The thirtieth anniversary of the (Swedish) Forestry Society.]** *Skogsägaren* 18, 1942 (217–8). [Sw.]

The activities of the Swedish Forestry Society, which celebrated its thirtieth anniversary on 29 November, 1942, are of a non-profit making nature. Its primary object has been to seek to promote forest economy by working for the establishment of afforested common lands in the possession of the communes and also for purposeful management of such forests.

The work of the Society now extends from Uppland down to the most southerly part of Scania. It is responsible for the management of 230 forests totalling more than 87,000 hectares. In the course of its activities 62 million plants have been set out, 5·5 tons of forest-tree seed have been distributed, and 1,744 miles of ditches have been dug, all in areas which had previously been either treeless moorland or neglected forest.

The Society's efforts have resulted in an increased annual production of nearly 120,000 cu. m. of timber, the felling and preparation of which have afforded as many man-days of work each year. R. P. J.

06.1 (71.4) : 12.19.1 : 4 : 60.31.2 : 23.24 : 5 : 34.3. Manuel des Clubs 4-H du Quebec. **[Manual of the 4-H Clubs of Quebec.]** *Bull. Ass. for. québec.* No. 5, 1943. pp. 136. [F.]

In 1942 the Quebec Forestry Association founded the 4-H Clubs of Quebec as an association of young people between the ages of 10 and 20 years who are working for conservation of the natural resources of the Province.

In this manual the organization and activities of the clubs are outlined and information is given on various aspects of forestry and wildlife in Quebec, the accounts being written by authorities on each of the subjects covered.

06.1 (73) : 90. GISBORNE, H. T. **The challenge to the Society of American Foresters.** *J. For.* 41, 1943 (803–7). [Northern Rocky Mt. Forest and Range Exp. Sta., Missoula, Mont.]

In this conference paper the author suggests that in the United States forestry should be concerned not only with the production and management of timber, but also with the management of all wildland resources such as water, forage, wildlife and recreation, and he urges that the Society of American Foresters interpret 'forestry' as being synonymous with 'wildlife management'.

07. EDUCATION AND RESEARCH. INSTRUMENTS AND TOOLS

07.1 : 97.2 (73) : 60.31.2. **Present status of farm-forestry education: report of Committee on Farm-Forestry Education, Division of Education, Society of American Foresters.** *J. For.* 41, 1943 (808–10).

07.2 (54). **Forest Research Institute, Dehra Dun.** *Nature, Lond.* 153, 1944 (201).

A brief resumé of progress made in forestry, and particularly in forest research, in India since the Secretary of State sanctioned proposals for the formation of the Indian Forest Service in 1862. The Forest Research Institute at Dehra Dun was inaugurated in 1906, and a research building was erected and opened in 1912. Later the work of the Institute was extended, and considerable increases were made in the research staff. A site of 1,200 acres was obtained and new buildings erected at a cost approximating a million pounds sterling. During the war of 1914–8, as well as in the present emergency, the Institute has played a very important part in evolving substitutes for many articles and materials that are imported into India in peace-time.

09.2. *Pre-history*

09.2 (410) : 12.19. GODWIN, H. **Coastal peat beds of the British Isles and North Sea.** *J. Ecol.* 31, 1943 (199–247). [Botany School, Cambridge.]

A survey of the submerged peat beds around the coast of the British Isles. The plant content of the beds and the conditions of their formation are discussed briefly, and the significance of coastal peats as evidence of former sea-levels is indicated. By analysis of pollen grains from the deposits the history of woodland growth in particular regions can be reconstructed. Pollen analysis has also shown that submerged peats have formed at all stages of the late-glacial or post-glacial period. The great period of post-glacial eustatic rise in sea-level is believed to have occurred at the time of the first expansion of warmth-loving trees. 09.2 (41.5). MITCHELL, G. F. **A composite pollen diagram from Co. Meath, Ireland.** *New Phytol.* 41, 1942 (257–61 + dgm.) [Trinity College, Dublin.] O.B.D.

A composite pollen diagram covering the whole post-glacial period and based on samples from near Dunshauglin, Co. Meath, is presented and discussed. The phases into which this diagram may be divided are compared with the zones already established in England and Wales. Until the post-glacial climatic optimum is reached, there is general agreement between the diagrams from eastern Ireland and from Britain (particularly the north and west). After the post-glacial optimum is passed, agreement is less strongly marked. Three archaeological horizons are represented in the diagram.

09.2 (73) : 12.25–8. BROWN, R. W. **Some prehistoric trees of the United States.** *J. For.* 41, 1943 (861–8). [U.S. Geological Survey, Washington, D.C.]

In prehistoric times the forests of the Rocky Mountain and Pacific States included species of *Ginkgo*, *Pseudolarix*, *Keteleeria*, *Glyptostrobus*, *Cercidiphyllum*, *Eucommia*, *Zelkova*, *Dipteronia*, *Koelreuteria*, *Ailanthus*, *Paliurus*, *Pterocarya*, *Callitris* and *Cedrela*. None of these genera have native representatives in this region to-day and their only survivors are native to other parts of the world, particularly eastern Asia. Associated with this group of genera in the western states were two other groups, one of genera now extinct in that region but represented by closely related species in the eastern States, and the second of genera which still have living representatives somewhere in the western States.

The distribution of the fossil and living species suggests former landbridge connexions as well as adaptation to other geologic changes during the Cenozoic era.

09.2 (77.5) : 12.25–8 : 11.21. WILSON, L. R., and WEBSTER, R. M. **Microfossil studies of three north-central Wisconsin bogs.** *Trans. Wis. Acad. Sci. Arts Lett.* 34, 1942 (177–93). Biol. Abstr. 17 (19575).

Notes and photomicrographs of common and abnormal spores and pollen are given. The fossils indicate that the lake forest was preceded by a boreal forest composed largely of White Spruce. Near the middle of the Pine forest period a small amount of hardwood pollen was found, including Hickory and Butternut, two species no longer growing within the region; these and other hardwood pollen may be interpreted as evidence of a warmer period of climate in late post-glacial time.

09.2 (79.7) : 12.25. HANSEN, H. P. **A pollen study of a montane peat deposit near Mount Adams, Washington.** *Lloydia, Cincinnati* 5 (4), 1942 (30–13). [Oregon State College, Corvallis.] Biol. Abstr. 17 (21154).

09.4. *Forest Statistics.*

09.4 (47.2–6) : 12.19 : 12.19.2. REINHOLD, F. Das Waldbild Russlands. [**The forest aspect of Russia.**] *Z. Weltforstwirt.* 9, 1942 (1943) (561–646 + plate). [G.e.f.]

A monograph based mainly on Russian literature. Statistics of Russian forestry are summarized, and the geographical distribution of over 200 tree species is indicated. Vegetation and forest types are discussed by geographical regions.

09.4 (489) : 65 : 56.04 : 76.2. ABELL, J. Et privat Skogdistrikt 1926 til 1941. [**A private forest district from 1926 to 1941.**] *Dansk Skovforen. Tidsskr.* 1942 (245–78). [Dan.] S.P.S.

Data are given on the wood capital, growth, depletion and income for a forest of 1,410 ha. in the district Hvidkilde during the period 1926–41. The forest had a wood capital of 236 cu. m. per ha., mainly Beech, Oak and Spruce.

09.4 (45) : 98.2. Betriebsstatistik der italienischen Holzwirtschaft. [**Statistics of Italian timber and wood-using enterprises.**] *Dtsch. Holzwirtsch.* 29 (59), 1942 (5), and *Int. Holzmarkt* No. 51/52, 1941 (48). *Abstr.* in *Z. Weltforstwirt.* 10, 1943 (106–7). [G.]

The first official census of all Italian business enterprises was undertaken shortly before the outbreak of war. According to the census data, the timber and wood-using enterprises, other than those of an artisan character, number 7,733, employ 102,289 persons, include 5,250 enterprises having motor power, and control an aggregate power of 131,938 h.p. For sawmills alone ('prima lavorazione del legno'), the corresponding figures are 2,916, 39,284, 2,306, and 74,070 h.p. In addition, there are 115,930 artisan enterprises. Between them, industrial and artisan enterprises account for 11·6 per cent. of all business enterprises in the country and employ 282,393 persons.

09.4 (496) : 98.2. HAFNER. Die türkische Holz- und holzverarbeitende Industrie. [**The Turkish timber and wood-products industry.**] *Z. Weltforstwirt.* 10, 1943 (211–2). [G.]

According to Yigitoğlu, industrial sawmills in operation in 1936 numbered 23 and had an annual capacity of 383,000 cu. m. in terms of round wood, but actually worked only 278,400 cu. m.; of this, 232,300 cu. m. was softwood timber, chiefly Fir and Pine. Nineteen of the mills were located in the coastal region along the Black Sea. There are also two paper and cardboard factories and one cellulose factory, all located in Smyrna; one artificial silk factory, at Gemlik; four plywood factories, in Istanbul; and one match factory, in the neighbourhood of Istanbul.

09.4 (497.1) : 98.1–2 : 8 : 9. HORVAT, I. Das Forstwesen Kroatiens. Eine statistische Darstellung. [**Forestry in Croatia. A statistical representation.**] *Z. Weltforstwirt.* 9, 1942 (415–33 + plate). [G.e.f.]

A summary of statistical data on the forests and the timber industry within the frontiers of the new Croatia, with notes on forest administration and policy. The total forest area is given at 4,068,703 ha. or 39 per cent. of the land area.

09.4 (74) : 98.1. SCHNUR, G. L. **Lumber production 1942—New England.** *Tech. Note Allegh. For. Exp. Sta.* No. 39, 1943. pp. [2].

09.4 (75.5) : 98.1 : 33.02. HOBART, S. G. **Virginia's pulpwood supply.** *Paper Ind.* 25, 1943 (259–62). [Virginia Forest Service.] L.S.

There are ten pulp mills in Virginia, and in 1940 the raw material used by nine of these mills totalled 834,300 cords of wood, 82 per cent. of which came from Virginia's forests. Although the total commodity drain for the state in 1940 was only 66·6 per cent. of the net growth, much of the surplus was in hardwood species, and the two most valuable pulpwood species—Loblolly Pine (*Pinus taeda*) and Shortleaf Pine (*P. echinata*)—are being overcut on the basis of present growth. In many places the Pine forests are being replaced by inferior hardwood species, particularly in Piedmont Virginia, where stands are generally understocked.

09.4 (77.4) : 98.2 : 12.25–8. HOLCOMB, C., and HERBERT, P. A. **Michigan's wood using industry.** *Quart. Bull. Mich. agric. Exp. Sta.* 26 (1), 1943 (25–31). [Lake States Forest Exp. Sta.]

Statistics are given for the number of industries using wood in the manufacture of finished products and the volume of lumber used by each in 1939, and for the volume by species obtained from various sources within the State and from other States and countries. The suitability of local woods for use by the re-manufacturing industries is discussed briefly; the most important Michigan hardwoods for this purpose are Maple, Beech, Oak, Ash, Basswood, Cottonwood and Elm.

09.4 (82) : 98.1 : 91.8. CASTRO, A. O. La riqueza forestal de Santiago del Estero. **[The forest wealth of Santiago del Estero.]** *Maderil* 15 (180), 1943 (7–8). [Span.]

This Province contains some 10½ million ha. of forest. At present as many as 130,000 workmen are connected in one way or another with forest exploitation, largely as a result of the boom in firewood and charcoal due to the drastic reduction in the import of petrol and coal.

09.7. *Monographs of Individual Forest Regions*

09.7 (494). FLÜCK, E. Das Emmental. **[The Emmental.]** *Schweiz. Z. Forstw.* 94, 1943 (223–30). [G.]

Notes on forestry conditions.

09.7 (59.5) : 91.1 : 98.2 : 07.1–2. CUBITT, G. E. S. **Forestry in Malaya.** *Brit. Malaya* 18, 1943 (225–7).

A brief statement dealing with the history and organization of the Forest Service, the development of forest reservation, the local timber industries, and forestry research and education.

09.7 (73) : 94 : 91 : 60.31.2. WATTS, L. F. **U.S.A. forest resources.** *Aust. Timb. J.* 9, 1943 (340–1, 343–4, 347, 359). [U.S. Forest Service.]

The author discusses various points relating to forest resources and conditions in the United States, including conservation measures, forest land ownership, the shelterbelt project, forests and recreation, and problems relating to the exploitation of privately owned forest lands.

1. FUNDAMENTAL NATURAL LAWS OF THE FOREST

11.1. *Atmosphere*

11.14. Precipitations. Evaporation. Humidity

11.14.3 (47.1) : 91.3 : 12.25–8. LUKKALA, O J. **The measurement of precipitation in different types of forest.** *Acta for. fenn.* 50 (23), 1942 (1–13). [Finn.g.] S.P.S.

Studies were made of the interception of rainfall by the forest canopy in stands of Spruce, Pine and Birch in southern Finland. It was found that the percentage of rainfall retained by the tree crowns varies with the amount of rainfall. Thus in a young closed stand of Spruce about 20 per cent. is retained with a rainfall of 20 mm. and 33 per cent. with a rainfall of 6 mm.

11.4. *Soil*

11.43. Biology of Soil, including Mycorrhiza

11.43.1 : 12.25. **The mycorrhizal relations of *Pinus*.** *Review* in *J. Ecol.* 31, 1943 (41–4).

A review of the work of Dr. M. C. Rayner on the mycorrhizal habit in relation to the growth of conifers (particularly *Pinus* spp.). The papers to which the review refers are published in *Forestry* 8, 1934 (96–125); 9, 1935 (154–5); 10, 1936 (1–22); 13, 1939 (19–35); 15, 1941 (1–36).

11.43.2 : 12.21 : 13.2 : 11.47.6. TURK, L. M. **Soil micro-organisms and their relation to soil productivity.** With discussion. *Proc. 18th nat. Shade Tree Conf.* 1942 (119–31). [Michigan State College, East Lansing, Michigan.]

The main types of soil organisms dealt with in this paper are bacteria, fungi, actinomyces, algae, protozoa, nematodes and earthworms. Among the beneficial effects brought about by certain of these organisms are:—(1) changes in the soil organic matter and its decomposition products, (2) fixation of atmospheric nitrogen, and (3) changes in the soil mineral constituents. The activities of these organisms may, however, have harmful results, such as:—(1) the production of plant and animal diseases, (2) denitrification, and (3) competition with higher plants for available nutrients. The addition of special bacteria-containing fertilizers to a soil will not necessarily result in its improvement, as the mere presence of desirable organisms is of less importance than the degree of their activity. Soils are usually well supplied with the necessary kinds of organisms (with the exception of legume bacteria). The problem is to provide suitable conditions for their proper functioning. This can be done to some extent by cultural means.

11.44. Surface Humus

11.44 : 12.25–8 : 11.43 : 11.42. WITTICH, W. **Untersuchungen über den Verlauf der Streuzersetzungen auf einem Boden mit Mullzustand. II. [Investigations on the disintegration of litter on a mull soil.]** *Forstarchiv* 19, 1943 (1–18). [G.g.]

The investigations deal with the decomposition of litter under the combined action of micro-organisms and of the soil fauna, and are a continuation of those reported in *For. Abstr.* 1 (76). Litter of different species was spread on a mull soil in a Pine-Beech stand; that of broadleaved species decomposed in the order:—Elm, Black Alder, Ash, Grey Alder, Acacia and Bird Cherry, Hornbeam and Sweet Chestnut, Sycamore, Linden, Oak and Birch, Aspen, Red Oak, and Beech, the decomposition of the Elm litter being the fastest. The C/N ratio appeared to be of decisive influence, decomposition being fast for litter having a low ratio. The decomposition of coniferous litter depended primarily on the soil fauna, being most rapid when the needles were carried quickly into the mineral soil. It was found that Larch litter was carried into the soil at a slower rate than that of Spruce, Douglas Fir, or Scots Pine. Observations were also made on the gradual changes in the chemical composition of the litter.

11.47. Maintenance of Favourable Soil Conditions

11.47 : 21.3 : 11.43.1. NEILSON-JONES, W. **Tree nutrition and soil fertility.** *J. For.* 41, 1943 (886–8). [Univ. of London.]

Investigations at the Wareham Forest have shown that the presence of a soil toxin tends to prevent both the introduction of short roots in Scots Pine seedlings and the subsequent conversion of these roots into mycorrhizae. Under field conditions the activity of the toxin-producing organisms can be suppressed, and the development of mycorrhizae stimulated, by mixing with the soil various composts, which thereby produce conditions favourable to the vigorous growth of the seedlings. The judicious application of suitable composts helps to hasten the successional changes in soil micro-organisms which normally accompany successional changes in surface vegetation in the transformation of grassland to woodland, and thus make it physiologically possible for trees to be planted successfully on such areas sooner than would otherwise be the case.

11.47.13 : 56.04. Walddüngung steigert Holzertrag. **[Fertilizing of forests increases the timber yield.]** *Forschungsdienst* 15, 1943 (104–5). [G.] A.P.B.

Results of 11-year trials with fertilizers in the Teutoburger Forest show that a higher yield can be expected from limed areas. The yearly increment was, on an average, 4 cu. m. per ha. greater on the fertilized than on the unfertilized plots. Under natural conditions fertilizing forest soils is unnecessary, but where natural conditions have been disturbed through an unsuitable choice of species, by litter removal, or by other types of human interference, fertilization guarantees a substantial increase in growth and opens up great possibilities of increased and intensive production.

11.47.6 : 11.47.12 : 11.43.1. BALFOUR, E. B. **The living soil: evidence of the importance to human health of soil vitality, with special reference to post-war planning.** Faber and Faber, Ltd., 24, Russell Square, London. 1943. pp. 246 + plates.

11.49. Soil Types

11.49 (213) : 11.21 : 61.32. VAGELER, P. Zur Problematik der kolonialen Bodenkunde. **[On the problem of soil science in the colonies.]** *Z. Weltforstwirt.* 10, 1943 (165–79). [G.e.f.]

The climatic soil theory, which originated in Russia, a country of temperate climate and of wide, flat plains that are little subject to erosion, is not applicable to the tropics, where soil erosion is very pronounced and in many cases does not permit the formation of fully matured soils consistent with the local climate. Only a theory that takes into consideration topography and the nature of the rock strata, in addition to the climate and vegetation, can be considered suitable for the tropics. The 'catena' theory does this, and areas of identical 'catenae' are the units to be used in pedological cartography rather than climatic soil-type zones. For unexplored or little-known territories, modern aerial photography, especially colour aerial photography, is an invaluable aid in soil mapping. Colour aerial photography was recently tested with satisfactory results by an expedition into the Atlas country of North Africa.

11.6. *Hydrographical Conditions. Water and Soil Conservation*

11.62.11 : 23.3 : 12.26–8. AHMAD, M. B. **Note on soil conservation demonstration plot at Kot Zendi, Fatehjang Range, Attock Soil Conservation Division.** *Indian For.* 69, 1943 (396–7).

A demonstration plot was started in 1940 at the plateau village of Kot Zendi, situated at about 1,364 ft. between the Kherimar and Kalachitta Hills, in order to show the villagers how cultivated lands should be terraced and embanked, culturable waste lands reclaimed, and run-off controlled. The work so far undertaken is briefly outlined.

11.62.11 (54.2). WARREN, W. D. M. **Soil erosion control in Bihar.** *Indian For.* 69, 1943 (431–4).

Both gully and sheet erosion are responsible for serious soil deterioration in the upland regions of Bihar. The author discusses briefly the harmful effects of erosion and the means of controlling it, particularly by restricting the felling of trees in hillside forests and by restricting or prohibiting grazing during the monsoon rains.

11.62.3 (68.7). WICHT, C. L. **The variability of Jonkershoek streams.** *J. S. Afr. For. Ass.* No. 10, 1943 (13–22).

The paper deals with the main features of characteristic hydrographs of Jonkershoek streams which have been plotted for streamflow years. It is noted that the total discharge of streams varies greatly from year to year, and that this is correlated with the wetness of the years. Special attention is paid to variability of the flow from one year to the next, and from one stream to another. From hourly readings of the rate-of-flow, frequency distributions are compiled. The 'standard deviations' and 'coefficients of variation' calculated from these are suggested as suitable numerical measures of streamflow variability. The derivation and value of 'flow-duration curves' are briefly discussed. *Author's summary.*

11.62.31 : 91.3 : 97.1. BURRAGE, C. H. **Forestry and land use in a flood-control survey.** *J. For.* 41, 1943 (873–6). [Tennessee Valley Authority.]

A brief account of the survey methods used and of the programmes formulated for improving land use in relation to flood control in the French Broad watershed, North Carolina.

12. FOREST BOTANY. TREE SPECIES

12.1. *General Botany*

12.11. Physiology. Reproduction. Growth

12.11. WENT, F. W. **Some physiological factors in the aging of a tree.** *Proc. 9th West. Shade Tree Conf.* 1942 (330–4). [California Institute of Technology, Pasadena, Calif.]

The usual age limit for most of the individuals cells of a tree is about one year, although in the case of a few conifers the cells composing the needles will remain alive for 5 to 10 years. The meristematic tissues, however, do not conform to the usual age limit. Experiments with tree cuttings show that they remain alive indefinitely. Like unicellular organisms these cells are capable of prolonged periods of life under favourable conditions.

Nevertheless the aging of the tree as a whole is clearly visible in a number of different phenomena:—

(1) decreased growth rate of branches and roots, (2) smaller leaves with a larger number of veins per unit area, (3) an increasing number of dead branches, and (4) narrower annual rings. These changes are largely produced by an increasing drought condition due to increasing difficulties of water transport and a consequent curbing of meristematic activity. Measurements have shown that the decrease in the availability of water is most rapid in trees which have a relatively short life, whereas in long-lived species such as the Sequoias the decrease in water availability is almost negligible. The increasing difficulties in the translocation of water in the aging tree are accompanied by similar difficulties in the transport of food and hormones. The cumulative effects of water, food and hormone shortages eventually make it impossible for the meristematic tissues to continue growth.

12.11.1. *Metabolism. Plant Constituents. Sap Flow. Growth Substances. Reserve Materials*

12.11.1 : 12.14.5 : 12.25 : 12.11.3. DEGELIUS, G. Tall med försenad klorofyllbildning. [**Pine with retarded chlorophyll formation.**] *Skogen* 30, 1943 (79).

This is a note on a young specimen of *Pinus sylvestris* L. f. *variegata* Carr. half a metre high, fresh and well developed, found in Västmanland; all the needles of its annual shoots were yellowish white owing to lack of chlorophyll. The fact that it stood near two normal Pines the same size as the 'albino' form is interpreted as indicating that the latter is genetically conditioned and not due to environmental factors. At a second inspection the tips of the needles had assumed a greenish colour.

Relevant literature on this rare form which occurs in both northern and southern Swedish Pines is mentioned. A similar form of Spruce is not quite so rare.

M. L. C. W.

12.11.11 : 12.26–8 : 12.14.7. CARTER, C. L., **Karakin, the glucoside of *Corynocarpus laevigata*, and hiptagenic acid.** *J. Soc. chem. Ind., Lond.* 62, 1943 (238–40). [Univ. of Otago, Dunedin, New Zealand.] P.R.

Karakin, a constituent of Karaka nuts, closely resembles hiptagin in chemical properties, their common hydrolytic product being hiptagenic acid. A second hydrolytic product of Karakin is aminoglucose or aminomannose.

12.11.11 : 12.26–8. MORRIS, P. F. **Poisoning by Eucalypts.** *Vict. Nat.* 60, 1943 (31). O.R.S.

Many species of Australian plants are said to be capable, under certain circumstances, of developing hydrocyanic acid (HCN) in poisonous amounts. Sugar Gum (*Eucalyptus cladocalyx*, F. v. M.) and Manna Gum (*E. viminalis*, Lab.) have both been suspected of causing the death of stock, while the timbers of Grey Box (*E. hemiphloia*) and Spotted Gum (*E. maculata*) are thought to have been responsible for skin irritation among bushworkers and sawmillers.

12.11.11 : 12.14.5 : 12.25. **Investigations on the mineral nutrition of dying Pine stands in the Reviere underwood.** *Sborn. čes. Akad. Zemědělské* 15, 1940 (423–9). *Chem. Zbl.* I, 1941 (2955). Chem. Abstr. 37 (6305). P.R.

The sulphur content of the needles of sound Pines of this region was 2–3 times as great as that of the needles of dying Pines and 3–4 times as great as that of the needles of sound trees in other regions. No other differences in mineral content of needles or wood were noted.

12.11.11 : 12.14.5 : 12.26–8. DICK, A. T. **The recovery of the glucoside aesculin from the Australian native plant *Bursaria spinosa*.** *J. Coun. sci. industr. Res. Aust.* 16, 1943 (11–4 + plates). P.R.

The leaves of *Bursaria spinosa*, a shrub or small tree, yield 4 to 5 per cent. of aesculin, and are therefore a possible source of local supply of this glucoside.

12.11.11 : 12.14.7 : 12.26–8 : 34.25. GROSSFELD, J. **Composition of Chestnuts.** *Z. Untersuch. Lebensmitt.* 84, 1942 (520–2). Chem. Abstr. 37 (5798). P.R.

The edible portion of the nuts of *Castanea vesca* Gärtner contain, on a water-free basis, protein (N × 6·25) 6·2, free fat 2·6, total fat 3·6, phospholipide P_2O_5 0·036, lecithin 0·39, sucrose 26·3, total sugars 29·2, starch 51·8, crude fibre 1·8, total ash 2·5 and CaO 0·046 per cent. The ash is quite alkaline.

12.11.11 : 12.14.7 : 12.26–8 : 34.25. HANSEN, E. **Ascorbic acid content of walnut hulls.** *Proc. Amer. Soc. Hort. Sci.* 42, 1943 (265–6). [Oregon Agricultural Exp. Sta., Corvallis, Ore.] E.M.B.

The percentages (dry weight) of ascorbic acid present in the involucres (hulls) of mature walnuts from various species of *Juglans* growing at the Oregon Experiment Station plot at Corvallis were as follows:—*Juglans nigra*, 8·34 per cent.; *J. californica* var. *hindsii*, 4·49 per cent.; *J. regia* (various varieties), 4·41–5·60 per cent. On a dry weight basis walnut hulls are a richer source of ascorbic acid than are rose hips.

12.11.11 : 12.14.7 : 12.26–8. LUND, A. P., and SANDSTROM, W. M. **The proteins of various tree seeds.** *J. agric. Res.* 66, 1943 (349–55). [Minnesota Agricultural Exp. Sta.] A.P.B.

This paper describes a peptization study of the proteins of seed of Ironwood (*Ostrya virginiana*) and Elm (*Ulmus americana*), and of several varieties of acorns from Red Oak (*Quercus borealis*, *Q. borealis* var. *maxima*, *Q. ellipsoidalis*) and White Oak (*Q. alba*, *Q. macrocarpa* var. *olivaeformis*). The major protein factors were isolated, and a study was made of these proteins according to the method of Van Slyke.

The seeds of Elm and Ironwood were shown to be rich in fat, and acorns from Red Oaks were observed to contain a higher percentage of fat than those of the White Oaks. All the acorns showed a low protein content; Ironwood seeds were somewhat richer in protein, while Elm seeds had a very high protein content. The major proteins isolated from the seeds of American Elm and of Ironwood were an albumin, a globulin, and a glutelin. From White Oak, Northern Bur Oak, and Northern Red Oak (*Q. alba*, *Q. macrocarpa* var. *olivaeformis*, and *Q. borealis*) only the glutelin fraction was obtained. The nitrogen content of all the acorns was low (the residual nitrogen accounting for from 18 to 40 per cent. of the total nitrogen content), but large amounts of alkali-soluble gums were present.

12.11.11 : 12.14.7 : 12.26–8. RUZICKA, L., JANETT, W., and REY, E. **Triterpenes. LXXII. Escigenin, the aglucon of saponin from Horse Chestnuts (*Aesculus hippocastanum* L.).** *Helv. chim. Acta* 25, 1942 (1665–73). Chem. Abtr. 37 (5958–9). P.R.

12.11 11–2 : 12.26–8 : 11.21. BHARUCHA, F. R., and NAVALKAR, B. S. **Studies in the ecology of Mangroves. III. The chloride-content of sea-water, soil-solution and**

the leaf cell-sap of the Mangroves. *J. Univ. Bombay* (Sci. No.) 10 (5) (*n.s.*) Sec. B, 1942 (97–106). [Royal Institute of Science, Bombay.] P.O.

A study was made of the part played in the bionomics of Mangrove vegetation by the chloride content (chiefly NaCl) of the sea-water and of the soil. Rainfall and temperature were observed to be important factors in determining the amount of chloride in both sea-water and soil, and consequently influenced the chloride content of the cell-sap. Seasonal variations in the chloride content of the sap is thus directly dependent upon climatic factors.

12.11.12. McGowan, J. C. **The reduction of carbon dioxide during photosynthesis.** *Chem. and Ind.* 62, 1943 (458–9). P.R.

12.11.13 : 12.26–8 : 34.24. Brito dos Santos, J. Estomas e actividade estomática no sobreiro. [**Stomata and stomatic activity in the Cork Oak.**] *Publ. Direc. ger. Serv. flor. aqüic., Lisb.* 7 (1), 1940. pp. 53 + plates. [Port.port.e.] L.S.

Investigations have shown that the stripping of bark from the Cork Oak (*Quercus suber*) was followed in a few hours by the complete closing of the stomata; the period of reduced stomatic activity varied between 24 and 30 days. The extent of stripping and size of the individual tree affected the speed and duration of the reaction.

12.11.15 : 12.11.22 : 12.25–8. Chaylakhyan, M. Kh., and Turetskaya, R. Kh. Kratkie metodicheskie ukazaniya po primeneniyu sinteticheskikh rostovykh veshchestv pri ukorenenii cherenkov. [**Brief methodical directions for the application of synthetic growth substances for the rooting of cuttings.**] Akademiya Nauk SSSR, Moscow and Leningrad. 1942. pp. 31. [Russ.] A.P.B.

The directions, in tabular form, are based on the investigations of Russian and foreign workers. Plants dealt with include *Picea* spp., *Salix caprea*, *Juniperus* spp., *Abies* spp., *Sequoia gigantea*, *Pinus* spp., *Tamarix gallica*, *Taxus* spp., *Populus alba*, *P. nigra*, *Thuja delabrata*, *T. occidentalis*, *Morus alba*, and *M. nigra*.

12.11.2. *Propagation. Growth. Development*

12.11.21 : 12.11.3. Lewis, D., and La Cour, L. F. **Collection of pollen and artificial wind pollination.** *Nature, Lond.* 153, 1944 (167–8). [John Innes Horticultural Institution, Merton Park, London, S.W.19.]

A new device, based on suction, for the collection of anther-free pollen grains, is described. The apparatus consists of a household vacuum cleaner with a suitable adaptor. By means of this apparatus pollen can be collected and conveniently stored in an attached removable tube. The same device with the air current reversed can be used as a pollinator. To regulate the amount of pollen delivered, a diluting 'powder' such as *Lycopodium* spores or talcum can be added. The authors claim that this method should greatly reduce labour wherever artificial pollination has to be carried out on a large scale, as in the breeding of fruit and forest trees.

12.11.21 : 12.26–8. Ellison, L. **A natural seedling of Western Aspen.** *J. For.* 41, 1943 (767–8). [Intermountain Forest and Range Exp. Sta.]

The author reports on what is believed to be the first seedling of Western Aspen (*Populus tremuloides aurea*) to be found growing naturally.

12.11.22 : 12.26–8 : 23.25. India and Burma. **Forest research in India and Burma, 1941–2. Part 1.—The Forest Research Institute.** Forest Research Institute, Dehra Dun. [1943?] pp. 151 + plates.

From experiments in the propagation of *Bombax malabaricum* from root sections it is shown that specimens with a 1½-in. shoot and 14-in. root gave better survival and height growth at the end of the first growing season than smaller material (p. 25).

12.11.22 : 12.26–8 : 12.14.4 : 22.22. Mikola, P. **On the production of coppice shoots in Birch and its importance in forestry.** *Acta for. fenn.* 50 (3), 1942 (1–102). [Finn.g.] S.P.S.

Coppice shoots can be produced from (*a*) roots, (*b*) the base of the stem, (*c*) the stump, (*d*) the parts of the stem above ground, (*e*) branches pressed into the ground. More shoots are produced by *Betula pubescens* than by *B. verrucosa* and more in Lapland than in southern Finland. Experiments have shown that shoot production is more vigorous the lower the stump and the younger the tree, and if trees are felled in November than if felled in June. Shoots give better growth on clear-cut areas than under shelter; site quality has practically no influence on shoot growth.

12.11.23 : 12.21. Björkman, E. **Some experiments on the effect of sodium arsenite on the growth of blue staining fungi.** *Norrlands SkogsvFörb. Tidskr.* 1941 (224–43). [Sw.g.] S.P.S.

Tests made in part on agar substrate and in part on wood showed that sodium arsenite was effective in checking the growth of *Leptographium lundbergii* and *Ophiostoma piceae* when used at concentrations of 0·02 and 0·08 per cent. respectively. At very low concentrations (0·001–0·0001 per cent.) sodium arsenite was observed to have a stimulating effect on the growth of the fungi.

12.11.3. *Heredity. Breeding. Hybridization. Races and Questions of Provenance*

12.11.3 (485) : 21.6 : 12.25–8 : 23.23.11. Inventering av elitstammer. [**Survey of élite trees.**] *Skogen* 30, 1943 (74). [Sw.]

The Swedish Department for Crown Lands has issued to all forest officials the directions here cited, in preparation for a survey of élite hardwood and softwood trees in Sweden. Elites presumably possess a superior genotype though their value must be verified by progeny tests in each case.

Elite trees are defined and directions given for their discovery and identification, and registration, as well as for their evaluation in progeny tests by forest officers.

Among the aims of the survey are:—the establishment of selected stands to act as a live store of superior seed and young plants, the promotion of forest tree breeding by the provision for that purpose of superior material from the Crown forests, and the protection of potentially valuable genotypes as sources of superior seed. M. L. C. W.

12.11.3 (485). Sylvén, N. Riktlinjer och önskemål vid svensk skogsträdsförädling. [**Lines of work and objectives in forest tree breeding.**] *Svenska SkogsvFören. Tidskr.* 41, 1943 (40–78). [Sw.]

In the course of surveys undertaken in Swedish forests to obtain basic information for tree-breeding work, it was found that natural selection within different tree species had produced definite species

types, which differed widely from each other in certain characteristics, including increment. Thus, the 'comb' Spruce has been found to be superior to Spruces of other branching habits in both height increment and diameter increment, while the wood of this type is equal to that of slower-growing types in density and in quality and output of sulphite pulp.

Since Spruces of different branching habit occur practically everywhere side by side under similar conditions and on the same type of soil, branching habit must in such cases be a genetically conditioned character. As all such species types are far from uniform in quality, varieties with coarse branches or other qualitatively inferior character, genetically conditioned, must be rejected for breeding purposes. Elite trees of the "comb" type have been selected for cone collection and progeny tests, and some "comb" Spruce stands, apparently of great value, have been reserved as "live seed stores" from which the greatest possible quantity of seed can be collected in each seed year.

Disease resistance is an important factor to be considered in the selection of seed trees. Work of the Association for Forest Tree Breeding has included the testing for susceptibility to disease of Spruce seedlings raised from seed collected from apparently rot-free trees growing in severely infected stands in different parts of Sweden.

In Pine selection the aim has also been to obtain types representing high quality as well as high production capacity, and special attention has been given to fine-branched types of the narrow-crowned Pine whose valuable characteristics have been defined by Lindquist (1935–42). Steps have been taken to create a living seed store in specially suitable élite stands in the crown forests in Lule Lappmark and in Småland. A remarkably rapid rate of growth has been recorded from progeny tests in some of the stands in Småland.

Since Birch breeding began, superior specimens, as regards both yield and quality, have received attention, the valuable curly Birch (masurbjörk), the Grey Birch (gråbjörk) and the wavy-grained Birch (flambjörk) being of particular interest to the breeder. Many élite trees of these types and of White Birch (glasbjörk) and warty Birch (wartbjörk) have been selected as mother trees and some of the seedlings are already undergoing comparison trials in different parts of the country. A fairly large percentage of 5-year-old plants from seed of mother trees of pronounced curly-Birch type exhibited definite curly-Birch characteristics when only 3 years old. Races of disease-resistant Birch have been sought and tests at Ekebo of different mother trees have shown marked differences in the susceptibility of the various progenies to rust. The great variation in the susceptibility of Birch to rot suggests that resistant races could be bred.

Work with the Aspen (*Populus tremula*), including giant forms and economically valuable local diploid races, has provided a starting point for Aspen breeding which has already given results of considerable practical value, including the discovery in different latitudes in Sweden of races differing in photoperiodism.

Surveys and selection of superior types of Oak, Beech, Ash, Elm and Alder for breeding purposes have also been carried out and in particular a relatively large number of progeny of different Oak trees from various parts of the country are undergoing comparison production trials at places in Scania, Östergötland and Västmanland.

Investigations have been made on hardiness in Spruce, Oak, Beech, Ash and Aspen. The central European or 'German' Spruce has proved specially productive in southern and central Sweden, but its lack of hardiness has prevented this strain from being grown further north. There is a wide range of variation for this characteristic and seedling selection during the recent severe winters, amplified by freezing-chamber tests made in the Association's laboratory, will, it is believed, give valuable practical results in the near future. Freezing experiments have also been used to demonstrate for Oak, Beech, Ash and other deciduous trees, a correlation between hardiness and earliness in autumn colouring and leaf shedding.

In addition to selection, both hybridization and chromosome alteration have also been used since the work at Ekebo started.

From work on Aspen crosses, carried out in a greenhouse with artificial lighting to induce flowering, about 600 different crosses between various parent trees have yielded large numbers of hybrid progenies which are now undergoing production trials in Scania, Småland, Värmland, Västerland, Dalarna, Angermanland and Västerbotten. From the growth and development of the young seedlings preliminary indications of the practical value of the various hybrid combinations has been obtained. The most promising hybrids have in recent years been multiplied for sale and planting out on a relatively large scale.

Long standing research on Poplars and Aspens at Ekebo has resulted *inter alia* in some hybrids of remarkably vigorous growth habit, e.g. crosses between Silver Poplar and [European] Aspen, and a series of particularly promising *Populus tremuloides* and *P. tremula* crosses. Some Poplar crosses that have been repeated are also highly promising.

Owing to the very variable set obtained in Elm crosses at Ekebo when cut branches were used, bottle grafting was generally adopted in 1942. Hybrids between local races of Elm and also between different Elm species are now being reared.

Since 1940 bottle grafting has been used in hybridization in the breeding of Birch, Spruce, Pine and Larch and other trees. With Birch it has been particularly successful and a big supply of well developed dwarf trees is now available as mother trees for all conceivable hybrid combinations. Among the numerous Birch crosses made in the past two winters are some between different Grey Birches, between extremely pronounced curly Birch forms, between different Swedish élite Birches and also between such Swedish Birches and different high-chromosome North American species used as the female parents, or Japanese species, etc., as pollen parents.

Crosses have also been made with trees in the open, and at Ekebo Black Alders (klibbalar)* of good forest type have been successfully used as ♀ trees in crosses with other varieties and also with other species of Alder. Since 1941 crosses have also been made with standing trees of Pine and of Spruce. The technique used is briefly described. Hybridization of Larch and a number of other foreign coniferous species was also

* Klibbal (*Alnus glutinosa* Gärtn.) so defined in *Bull. Yale Univ. Sch. For.* No. 40. Swedish-English Vocabulary for Foresters.

carried out in the open in 1941 and 1942. At Grensholm in Ostergötland and in the Swedish Seed Association's (Sveriges Utsädesförenings) grounds at Svalöf, crosses were made with selected mother trees of various Larch species and the seedlings are now being raised at Ekebo, as well as hybrids from different interspecific crosses of *Picea*, *Pinus*, *Abies*, *Pseudotsuga* and *Chamaecyparis*, one aim in this group being specially vigorous growth.

Following the recent discovery of giant Aspens with a much higher volume yield than the diploid, a tetraploid Aspen of a specially vigorous type with 76 (57 + 19) chromosomes has been produced. After the discovery of female giant Aspens, which made crosses of gaint forms of different sexes also possible, further crossing experiments with Aspens of various types have resulted in a number of new tetraploid Aspens of value for further breeding operations. Results with colchicine treatment of seeds and the tips of growing shoots, which produced chromosome doubling in many plants, have also been applied recently at Ekebo to Aspen, Beech, Alder, Oak, Pine, Spruce and Larch, and results of practical value have been recorded, especially with Aspens and Birches.

To hasten the breeding process, research has been conducted on vegetative propagation, and new methods of propagating selected élite Aspens and other species by root cuttings have been tested successfully on a large scale.

Still more successful experiments with Birch have been made using layering and grafting, and Birch has also been propagated using shoots from stumps of felled trees. Thus no great difficulties should be encountered in the vegetative propagation of this species even on the scale needed in practical forestry; and similar possibilities appear to be within reach for other deciduous trees.

In view of the importance in breeding work of inducing flowering in young seedlings, experiments with the well-known method of strangulation or constriction with steel wire have been tried with young conifers and deciduous trees. The results in Spruce stands are looked forward to with interest, particularly as a means of increasing seed production to provide better facilities for regeneration in the difficult mountain forests.

The outcome of investigations on the induction of flowering by various methods in tetraploid Aspen seedlings is eagerly awaited, one of the ultimate aims being to obtain triploids from diploid × tetraploid crosses. From such triploids large numbers of other triploids could be obtained by vegetative propagation.

M. L. C. W.

12.11.3 (485). Sylvén, N. La sélection des arbres forestiers en Suède. **[Forest-tree selection in Sweden.]** *Intersylva* 2, 1942 (471–8). [F.g.e.span.ital.] [Association pour la sélection des arbres forestiers, Ekebo, Suède.]

Forest tree selection has been promoted in Sweden chiefly by the Forest Tree Breeding Association founded in 1936, which began work in spring of 1938. This article deals with the development and work of the Association and gives short notes on investigations carried out under its auspices, indicating the literature in which this work has been reported. Mention is made of the author's work with Pine and Spruce, of recent experiments with Birch in which use was made of vegetative propagation and grafting, of H. Nilsson-Ehle's discovery of the Giant Aspen in Scania, of recent hybridization experiments with Aspen and Poplar, of experiments with colchicine on Aspen and other species for the production of individuals with a high chromosome number, of the discovery of Aspen races differing in photoperiodism, and of research on the winter resistance of Spruce, Oak, Beech, Ash, and Aspen and the disease resistance of different species. [Cf. preceding abstract.]

12.13. Embryology

12.13 : 12.25. Allen, G. S. **The embryogeny of *Pseudotsuga taxifolia* (Lamb.) Britt.** *Amer. J. Bot.* 30, 1943 (655–61). O.B.D.

The development of the microspore and male gametophyte of *Pseudotsuga* follows closely that described for *Pinus*. The mature pollen grain is intermediate between *Pinus* and *Abies* with respect to division of the antheridial cell.

The development of the female gametophyte up to fertilization has been described by Lawson (1909) and confirmed by the present study. The zygote divides to form eight free nuclei near the centre of the egg; four move toward and four away from the micropylar end of the egg. The antipodal nuclei divide and cell walls are formed to produce an open tier and an embryo tier; the cells of the embryo tier divide to cut off a suspensor tier which elongates and forces the embryo tier into the gametophyte tissue. With respect to the number of tiers in the proembryo, *Pseudotsuga* is intermediate between *Abies* and *Pinus*.

The four free nuclei near the micropylar end of the egg remain undivided and disintegrate in a few days; occasionally they may divide and even form cell walls. This represents the fourth division of that part of the zygote and appears to be homologous with the production of the eight nuclei of the open and rosette tiers of *Pinus*. It may, however, represent the development of a ventral proembryo homologous with the rosette embryo of *Pinus*.

Some evidence is presented which suggests that the ventral canal cell may occasionally be fertilized or it may divide, or divisions of the supernumerary pollen tube nuclei may occur at the micropylar end of the egg. *Author's summary.*

12.13 : 12.26–8. Horn, C. L. **The frequency of polyembryony in twenty varieties of Mango.** *Proc. Amer. Soc. hort. Sci.* 42, 1943 (318–20). [Puerto Rico Exp. Sta., Mayaguez, P.R.] E.M.B.

In order to investigate the occurrence of polyembryony, studies were made of 7,880 Mango seedlings of 20 varieties. A table is given showing the total number of seedlings of each variety which were examined, the percentage of polyembryonic seedlings of each variety, and the percentage of monoembryonic seedlings which were (*a*) branched and (*b*) unbranched below the soil surface. Variety *cambodiana* showed the highest percentage of polyembryony (43·96 per cent.).

12.13 : 12.26–8. Murthy, S. N. **Morphological studies in the Sapotaceae. I. Embryology of *Bassia latifolia*, Roxb., and related genera.** *Half-Yearly J. Mysore Univ., Sect. B.* 2 (2), 1942 (67–79). [Central College, Bangalore, India.] Biol. Abstr. 17 (24765).

12.13 : 12.26–8. Nast, C. G. **The embryogeny and seedling morphology of *Juglans regia* L.** *Lilloa, Tucumán* 6 (1), 1941 (163–205 + plates). Biol. Abstr. 17 (20619).

12.14. Organography. Morphology. Anatomy. Histology

12.14.2 : 12.26–8. PRIESTLEY, J. H. **The cuticle in Angiosperms.** *Bot. Rev.* 9, 1943 (593–616). [Univ. of Leeds.]

12.14.3 : 12.25 : 21.6. REHÁK, J. Chudové kořeny. **[Stilt roots.]** *Lesnická Práce* 21 (4/5), 1942 (200–8). Biol. Abstr. 17 (25054).

The occurrence of abnormal stilt roots on Spruce in certain localities in the Böhmerwald is attributed to the influence of running water, which made the establishment of seedlings difficult except on raised spots such as decaying stumps, mounds of earth, and rocks.

12.14.4–5 : 12.26–8 : 31.1 : 31.3. LACOMBE, N. R., and YOUNGKEN, H. W. **Studies on the anatomy of *Rhamnus lanceolata* Pursh and *Rhamnus frangula* L.** *J. Amer. pharm. Ass.* (*Sci. Ed.*) 32, 1943 (193–202). [Massachusetts College of Pharmacy, Boston, Mass.] L.S.

This investigation deals with the anatomy of the stem, leaf and petiole of *Rhamnus lanceolata* and *R. frangula* (= *Frangula alnus*); the anthraquinone content of the two species is referred to briefly.

12.14.5 : 12.25–8 (72 : 728.1 : 728.2). EGLER, F. E. **Leaf key to common forest trees of the Yucatan Peninsula.** *Carib. For.* 5, 1943 (1–19). [E.span.] [Chicle Development Co. Exp. Sta., New York State College of Forestry.]

12.14.5 : 12.26–8 (54) : 21.8 : 12.19. D'ALMEIDA, J. F. R., and DESAI, J. L. **A contribution to the study of the ecological foliar anatomy of Indian plants.** *J. Univ. Bombay* (Sci. No.) 10 (5), (*n.s.*), Sec. B., 1942 (1–58). [St. Xavier's College, Bombay.] P.O.

A study was made of the anatomical features of the leaves of some Indian plants (trees, shrubs and herbs) from Salsette, a typical monsoon region, with reference to the effect of environment on leaf anatomy. The plants studied are subjected each year to two entirely different sets of climatic conditions, such that modifications in leaf anatomy might reasonably be expected to take place. In the case of tropical forest trees and shrubs (whether evergreen or deciduous), however, the leaf structure is predominantly xerophytic (or xeromorphic), and appears scarcely to be affected by the change of seasons with alternation of wet and dry periods. Moreover, except in the case of *Euphorbia neriifolia* L. (an erect, fleshy, glabrous shrub or small tree with mesophytic leaves adapted for moist monsoon conditions when the plant is in leaf), no difference in structure was noted between the leaves of evergreens and those of deciduous species. In most cases leaf-shedding occurs some time during the dry period, but the leafless condition does not synchronize with the driest period of the year and is often of short duration. New leaves frequently appear long before the rains, at a time when conditions are most severe. Sometimes leaf-fall indicates that the tree is preparing to blossom and may be due to the monopolizing of the transpiration current by the swelling buds. It is evident from the observations made that leaf-fall and the appearance of new leaves depend to a great extent on internal factors rather than environment.

One striking feature of the leaves of many forest trees is the strong and often close reticulate venation which marks off definite areas of leaf tissue as photosynthetic units. When the units are bounded by meshes of veins extending from epidermis to epidermis and are possibly further strengthened with sclerenchyma, they become isolated, water-tight compartments, so that if one unit is injured there is no danger of dessication in neighbouring units or in the rest of the leaf. In general, the various types of leaf structure appear to be a compromise to meet the requirements both of the vital processes and of mechanical strength.

Descriptions of the leaf anatomy of various plants are preceded by notes on the general character of the species under review. The main part of the work is divided into 3 major sections:—(1) deciduous trees and shrubs, (2) evergreen trees and shrubs, and (3) herbs. The tree species dealt with include *Gossampinus malabarica* (= *Bombax malabaricum*), *Lannea grandis* (= *Odina woodier*), *Semecarpus anacardium*, *Erythrina indica*, *Butea monosperma* (= *B. frondosa*), *Pongamia glabra*, *Terminalia catappa*, *T. belerica*, *Careya arborea*, *Tectona grandis*, *Gmelina arborea*, *Bridelia retusa*, *Anacardium occidentale*, *Mimusops elengi*, *M. hexandra* and *Artocarpus integrifolia*.

12.14.6 : 12.25 (485) : 12.11.3. LINDQUIST, B., and RUNQUIST, E. Krontypsvariationen hos den smalkroniga tallen i Norrland. **[The variation in crown type in the narrow-crowned Pine in Norrland.]** *Skogen* 30, 1943 (69–72). [Sw.]

The northern Swedish Pine, which is narrow crowned, and the southern Swedish Pine, which is broad crowned, have long been regarded as distinct types based essentially on genotypic differences, but the detailed study of variation in the Swedish Pine population is not yet complete. The authors here make their contribution to the subject by outlining the four large geographical groups of Pine in Norrland and describing various well known variants of the narrow crowned Pine with notes on their possible origins, incidence and economic value.

In one group a type is sometimes found with broad crown combined with narrow top; it is attributed to bud mutation.

The various types of narrow crown, classified by the angle of the branches to the trunk, their position and size, and the crown profile, etc., are shown by illustrations and photographs. One of the conical pointed narrow forms of crown (spetssmalkrone) is regarded as of possible value for breeding work, though of minor importance in practical forestry. The 'worm Pine' (ormtallen), with its defective system of branches of the second order, possibly due to a loss mutation, ranks mainly as a curiosity.

The fact that the same type occurs in different climatic regions and on sites of very different qualities suggests that all these types are probably genetically distinct and are based fundamentally on the numerous possible genetic combinations affecting the formation of crown and branches in the Pine. This variation could be exploited in breeding the Norrland Pine.

W. L. C. W.

12.14.7 : 12.25. SNOW, A. G., DORMAN, K. W., and SCHOPMEYER, C. S. **Developmental stages of female strobili in Slash Pine.** *J. For.* 41, 1943 (922–3). [Southern Forest Exp. Sta.]

For success in controlled tree breeding a good knowledge of the appearance of the flowers at various stages of development is important. Illustrated descriptions are given of several stages of development of female strobili on *Pinus caribaea* that are used as criteria in breeding work.

12.14.7 : 12.26–8. BAILEY, I. W., and NAST, C. G. **The comparative morphology of the Winteraceae, II. Carpels.** *J. Arnold Arbor.* 24, 1943 (472–81 + plates). [Harvard University.]

An account is given of the comparative morphology of the carpels of the Winteraceae, including those of the genera *Drimys* (*Tasmannia* and *Wintera* sections), *Bubbia*, *Belliolum*, *Exospermum*, and *Zygogynum*. The chief trends of specialization are indicated, and reference is made to the significance of internal papillate surfaces.

12.14.8 : 12.25. ISENBERG, I. H. **The anatomy of Redwood bark.** *Madroño* 7, 1943 (85–91 + plates). [Institute of Paper Chemistry, Appleton, Wis.] A.P.B.

This paper is a portion of a botanical study made at the Institute of Paper Chemistry, Appleton, Wisconsin, in 1939. It deals with the anatomy of the bark of *Sequoia sempervirens* (Lambert) Endlicher. The bark of this species is thick (occasionally up to 1 ft.), reddish, deeply furrowed and scaly. In transverse section two distinct layers are visible—a very thin, whitish inner layer, rarely exceeding ¼ in. in thickness, and a thicker reddish-brown outer layer.

Short descriptions are given of the anatomical features of the secondary phloem (consisting of sieve cells, longitudinal parenchyma, phloem fibres, and ray parenchyma) and of the periderm. Variations in the bark structure were examined on micro-sections, special attention being given to material from a piece of bark about 7 in. thick. Micro-chemical tests were made to determine the nature of the reddish-brown colouring matter which is deposited on all cell walls of the outer bark and is particularly conspicuous in the ray cells and the cells of the periderm.

12.14.8 : 12.26–8 : 12.11.11. CLOTOFSKI, E., and HERR, W. **Beech bark (*Fagus sylvatica*) III.** *Ber.* No. 75 B, 1942 (237–43). *Chem. Zbl.* I, 1942 (2148). Chem. Abstr. 37 (4425). P.R.

An account of some of the chemical constituents of the bark of *F. sylvatica*. [Cf. *For. Abstr.* 5 (17).]

12.14.8 : 12.26–8 : 12.11.11 : 34.24. LUCKHOFF, H. A. **Histological distribution of Wattle bark tannin.** *J. S. Afr. For. Ass.* No. 10, 1943 (40–50).

A general account is given of the anatomy of Wattle bark. Numerous sections of bark were cut, stained and examined under the microscope, and detailed descriptions are given of the bark of Black Wattle (*Acacia mollissima*), representing four regional classes, and of Green Wattle (*A. decurrens*), Silver Wattle (*A. dealbata*) and Java Wattle (probably *A. decurrens*). The examination showed a systematic distribution of tannin among the various structural elements which differed in some species and in barks from different regions. It is concluded that microscopic examination is of no value as a means of assessing quantitatively the tannin content of bark.

12.19. Geographical Distribution. Plant Geography and Sociology

12.19 (43.7) : 12.25 : 65 : 09.4. RUBNER, K. Das Areal der Sudetenlärche. **[The area of the Sudeten Larch.]** *Thar. forstl. Jb.* 94, 1943 (1–99 + map). [G.]

A report on the results of a census to determine the distribution of the Sudeten Larch in the eastern Sudeten country. A detailed map shows the location of the different Larch stands and the distribution of the growing stock and races, Sudeten or other. The ecological environment of the Sudeten Larch woods and statistical data obtained on areas and standing volumes are discussed.

12.19 (67.6). THOMAS, A. S. **The vegetation of the Karamoja district, Uganda. An illustration of biological factors in tropical ecology.** *J. Ecol.* 31, 1943 (149–77 + plates). [Department of Agriculture, Uganda.]

The vegetation of Karamoja is classified and described under the following headings:—(1) Open grasslands of the plains in the south and west; (2) woodlands of the hills in the south and west; (3) grasslands of the broad valleys in the centre of the district; (4) cultivated land in the east; (5) grasslands in the east; (6) riverain forests; (7) woodlands in the east and north; (8) Acacia woodlands and thickets in the east; (9) mountain vegetation (woodlands, forests, shrubby moorlands, grass moorlands). The influence of settlement, cultivation, and grazing on the vegetation and the soil are discussed, and reference is made to the role of biological factors in tropical ecology, and more especially to the effects brought about by the action of termites, game animals and man.

12.19 (74.8) : 12.19.2 : 12.19.4 : 21 : 12.25–8 : 60.3. HOUGH, A. F., and FORBES, R. D. **The ecology and silvics of forests in the high plateaus of Pennsylvania.** *Ecol. Monogr.* 13, 1943 (299–320). [Allegheny Forest Exp. Sta.]

A study was made of the distribution, composition, and ecological significance of the forest associations in the northern portions of the Allegheny Plateau in Pennsylvania.

Virgin stands included areas of White Pine and associated species, and of the Hemlock/Beech and Beech/Maple associations. Intensive studies were made of the age distribution of the principal species in relation to climatic and other site factors: these species include White Pine (*Pinus strobus*), Hemlock (*Tsuga canadensis*), Beech (*Fagus grandifolia*), Sugar Maple (*Acer saccharum*), Red Maple (*A. rubrum*), Birches (*Betula* spp.), Black Cherry (*Prunus serotina*), and White Ash (*Fraxinus americana*).

Second-growth stands established after logging and fire are represented by two major associations:—(1) those containing White Pine, and (2) those dominated by Beech, Black Cherry, Sugar Maple and Yellow Birch (*Betula lutea*). The chief factors influencing the species composition of second-growth stands are destructive forest fires and excessive logging in the original stand.

Ecological relationships between the major virgin forest associations are simple. The White Pine association is a long-lived sub-climax; Hemlock/Beech is the characteristic climax; Beech/Maple is a phase of the Hemlock/Beech climax due to the local absence of Hemlock. The second-growth forests are all sub-climaxes created by retrogressions, the White Pine types being especially impermanent and difficult to perpetuate under forest management. The various hardwood/Hemlock mixtures dominated by Beech will gradually revert to the climax in the absence of further destruction due to heavy cutting and fire, and may be handled readily by partial cuttings for both cordwood and sawlogs. *From authors' summary.*

12.19 (75) : 43 : 12.25–8. GARREN, K. H. **Effects of fire in vegetation of the southeastern United States.**

Bot. Rev. 9, 1943 (617–54). [Georgia Agricultural Exp. Sta.]

A review of the effect of fire on the 18 major vegetational (chiefly forest) types of the southeastern United States. The Longleaf Pine (*Pinus palustris*) forests in this area have probably originated as a result of fire and represent a fire sub-climax. Frequent winter fires in the proper ratio to fire-free years appear to be an essential factor in the maintenance and perpetuation of this forest type. Indirect evidence suggests that repeated burning may also be responsible for the Longleaf/Scrub Oak forests of the Southeast.

Although not as fire-resistant as Longleaf Pine, Slash Pine (*Pinus caribaea*) is less sensitive to fire than are most hardwoods, and the Slash Pine forests of southern Florida appear to have originated in areas where hardwoods have been destroyed by fire. Similar forests in the Longleaf Pine belt, however, have more probably resulted from the invasion of protected Longleaf areas by the faster-growing *Pinus caribaea*.

The effect of fire on White Cedar swamps varies according to the season of burning and the time elapsed since the last fire. Pure stands may be formed or the species may be entirely eradicated. The upland Red Cedar/hardwood forests are found only on areas which have escaped fire, while the Oak/Hickory forests of the Southeast seem to be confined to areas where fires are infrequent. Upland forests of Scrub Oak have originated through continued burning of mixed forests. The grass-sedge bogs are definite fire sub-climaxes, and when protected from fire will revert to forest.

12.19 (76.4 : 78.8–9 : 79.1–4) : 12.25. WHITING, A. E. **Junipers of the Flagstaff region.** *Plateau* 15 (2), 1942 (23–32). Biol. Abstr. 18 (1493).

Methods of identification and ranges are given for *Juniperus scopulorum*, *J. pachyphloea*, *J. monosperma* and *J. utahensis* in Arizona, New Mexico and adjoining states.

12.19 (77.7) : 11.1–4 : 91.1. HAYDEN, A. **A botanical survey in the Iowa lake region of Clay and Palo Alto Counties.** *Iowa St. Coll. J. Sci.* 17, 1943 (277–415).

A survey of the flora of the Clay and Palo Alto Counties was undertaken as part of a co-operative research programme with reference to plants useful to waterfowl. The low precipitation/evaporation ratio limits the growth of forests in this area, the climax vegetation of which is grassland. There are, however, invasions of the eastern and northern broadleaved forests along some of the streams and in moist depressions in the open prairie. The most notable forest development in the two counties is the Wanata State Park where the Oak/Hickory and Maple/Basswood dominants shelter a considerable number of secondary woody plants. An annotated list of the plant species found in the area is appended.

12.19.1. *Regional Floras*

12.19.1 (51) : 12.26–8. HUI-LIN LI. **Notes on the flora of Kwangsi Province, China.** *J. Arnold Arbor.* 24, 1943 (444–59). [Arnold Arboretum.]

This study is based on a few selected families of plants from Kwangsi Province in southern China, and includes descriptions of 26 new species and two new varieties. The following tree species are recorded:—*Helicia vestita* var. *mixta* var. nov., *Reevesia tomentosa* sp. nov., *Hydnocarpus merrillianus* sp. nov., *Alangium chungii* sp. nov. (shrub or small tree), *Diospyros siderophyllus* sp. nov., *Symplocos mollipila* sp. nov. (shrub or small tree), *S. punctato-marginata* (shrub or small tree), and *S. myriadenia*.

12.19.1 (71.1) : 12.25–8. [STANWELL-FLETCHER], J. F., and STANWELL-FLETCHER, T. C. **Some accounts of the flora and fauna of the Driftwood Valley region of north and central British Columbia.** *Occ. Pap. B.C. Prov. Mus.* No. 4, 1943 (1–97 + plates). Biol. Abstr. 17 (19422).

The dominant cover of the Driftwood River Valley, 40 miles north of Takla Lake, is *Pinus contorta* var. *murrayana*, *Picea mariana*, *P. glauca*, *Abies lasiocarpa*, *Populus tremuloides* and *P. balsamifera*. Annotated lists of the flora and fauna are given.

12.19.1 (729.1) : 12.19.2–3. SEIFRIZ, W. **The plant life of Cuba.** *Ecol. Monogr.* 13, 1943 (375–426). [University of Pennsylvania.]

From the point of view of physiognomical ecology Cuba has been divided into nine major associations:—(1) coast, (2) desert, (3) thicket, (4) limestone, (5) savanna, (6) cultivated lands, (7) communities and guilds, (8) forests, and (9) alpine vegetation; and a final chapter has been added on the vegetation of the Maisi district at the eastern tip of Cuba, which consists of five distinct plant associations, each of which is typical of a part of Cuba. Oriente is the most forested Cuban province, although some good woods occur on the slopes of the Trinidad Mountains in southern Santa Clara. In this paper the forests on the southern slopes of Pico Turquino are treated in detail, and short lists are given of forest plants occurring in northern Oriente and southern Santa Clara provinces. Among the most valued trees of the Cuban forests are Jigue or Sabicu (*Lysiloma sabicu*), Mahogany (*Swietenia mahagoni*), Guajacan or Lignum Vitae (*Guaiacum officinale*), Mahagua (*Hibiscus tiliaceus*), Granadillo or West Indian Ebony (*Brya ebenus*), Agua Baria (*Cordia gerascanthus*), Ocuje (*Calophyllum antillanum*), Acana (*Achras dissecta*), and Caigarán (*Hymenaea cubaril*).

Tree species also occur in some of the other major associations, each of which is described.

12.19.2. *Forest Types*

12.19.2 (43.1–5) : 65.1 : 12.26–8 : 22.21 : 63. FRIC, J. Lesy lužní. [**Bottomland forest.**] *Lesnická Práce* 21 (6), 1942 (227–36). Biol. Abstr. 17 (25017).

Bottomland forest of the middle Elbe is generally mixed broadleaf forest. Best management is by the coppice-with-standards system, with a 40-year rotation for the understorey and 80- to 100-year rotations for the overstorey. The native species are Pedunculate Oak, Ash, Elm, Norway Maple, Linden, and Poplar in both over- and understorey, and Alder, Hornbeam, *Acer campestre*, and various small trees in the understorey alone. Overstorey trees should not be too numerous; according to an old rule, 30 large trees per ha. should be the maximum number.

12.19.2 (729.7). BEARD, J. S. **A reclassification of the forest types of Trinidad, B.W.I.** [Typescript.] 1941. pp. 111 + plates.

Following the earlier work on forest ecology in Trinidad, which was begun by the Forest Department in 1927, and the publication in 1934 of R. C. Marshall's 'The Physiography and Vegetation of Trinidad and Tobago' (*Oxford Forestry Memoir* No. 17), the author of the present paper has made a comprehensive reanalysis of previous strip-survey records and has completed a detailed investigation of the forests of the

Northern Range. In the course of this work a number of new plant associations have been recognized bringing the total up from twenty-one to thirty-five. 'It is the purpose of the present work to describe the new associations and to re-describe the old ones along up-to-date lines, and to attempt an acceptable classification of them all into formations'. In constructing the new classification the author has followed closely the report of the Committee of the British Ecological Society—'The Recording of Structure, Life-Form and Flora of Tropical Forest Communities as a Basis for their Classification' (*Pap. Imp. For. Inst.* No. 19)—and has referred to what other work has been done on the classification of parallel or similar types in tropical America, Africa and India.

The basic unit used by the author is the plant association; associations of similar structure and life-form are then grouped into formations. While the association is a floristic unit and is an expression of the local habitat, the formation is a physiognomic unit consisting of one or more associations of like structure, and is the expression of its essential habitat. In Trinidad, a total of twenty-two forest and woodland associations are recognized and can be grouped physiognomically into eleven formations. The formations and associations are tabulated and their distribution shown on a map.

The plant formations are discussed with reference to their essential habitats, primary consideration being given to the soil-water factor; on this basis the formations are classified into five drought-relation groups:—(1) Well-drained lowland group, experiencing actual drought; (2) badly-drained lowland group, alternating actual and physiological drought; (3) inundated lowland group, experiencing physiological drought; (4) montane group with ascending relative physiological drought; (5) littoral group with relative physiological drought.

In the last and major chapter of this paper the author gives detailed descriptions of the structure and life-form of the eleven plant formations, and of the floristic composition and local habitat of the twenty-two plant associations.

12.19.2 (74.8) : 12.19.4 : 11.49 : 11.1. HOUGH, A. F. **Soil factors and stand history in virgin forest valley on the northern Allegheny Plateau.** *Soil Sci.* 56, 1943 (19–28). [Allegheny Forest Exp. Sta.] O.R.E.

Results of a study of the relationship between tree species and soils on ten 1-acre plots situated in the virgin forests of East Tionesta Creek valley in northwestern Pennsylvania. Five of the plots selected were in the Hemlock/Beech association, which had not been disturbed by forest fires for a period of 400 to 500 years. The evidence seems to indicate that this type of forest tends to re-establish itself as the climatic climax association on all habitats of the High Plateau region regardless of soil type.

Beech/Maple forest, including some 300- to 400-year-old relict Hemlock, as well as younger understorey Hemlock, occurred as a physiographic subclimax on Cookport and Dekalb soils, largely as a result of drought and windthrow damage in the past. On the south and southeast slopes of the valley were two areas of a long-lived White Pine/Hemlock association. The older stand, in which White Pine was initiated by a fire in 1644, occupied a strongly leached Leetonia stony loam soil type or a rocky slope sheltered from the force of the severe storm of 1820 which resulted in the invasion of the second area (Cookport silt loam) by White Pine after the windthrow.

As a rule, the soils of the subclimax White Pine, Hemlock were lower in silt-plus-clay content than those of the Beech/Maple or Hemlock/Beech associations, but although soil characteristics, especially the humus horizon, were related in some degree to the major forest associations, it is apparent that the long-term effects of various climatic and biotic factors are fully as important as soils in the conditioning of forest types.

12.19.2 (75.5) : 12.26–8 : 12.19.4. ALLARD, H. A. **The Locust consocies in the developmental forest of Bull Run Mountain, Virginia.** *Ecology* 24, 1943 (485–92).

The more or less abundant Locust (*Robinia pseudoacacia*) consocies of the Bull Run area of Virginia are essentially a developmental type of xeric woodland representing the earliest stages of forest succession. The mixed hardwood stands in the area are of much older growth, but the Pine, Tulip Poplar and Locust woods appear to be very nearly of the same age. The light-demanding Locust stands, however, show very little competitive ability when in contact with Pine or Tulip Poplar.

A detailed study of conditions in a 10-metre quadrat of one of the better-developed Locust consocies about 25 years of age indicated that the smaller Locust trees are gradually being eliminated from the stand and that this species is not reproducing. Although 12 young Locusts out of the 33 Locust trees in the quadrat were found to be dead, all the young Ash (2), Tulip Poplar (1), and Black Cherry (4) that had invaded the area had survived. These will probably become components of the mixed hardwood climax that will eventually displace the Locust consocies.

The herbaceous and shrub flora which thrives beneath the Locusts is distinctive in character. The Spice bush (*Lindera benzoin*) is the most successful undershrub, while the herb stratum consists of a mixture of native species belonging to the climax forest and a weedy flora peculiar to waste ground. The exceptional luxuriance of the undergrowth may be attributed in part to the soil improvement brought about through the agency of the nitrogen-fixing bacteria present in the roots of the leguminous Locusts.

12.19.3. *Other Vegetation Types*

12.19.3 : 12.23 (729.6). STEHLÉ, H. La végétation muscinale des Antilles françaises et son intérêt dans la valorisation sylvicole. [**The moss vegetation of the French Antilles and the interest it presents from a silvicultural point of view.**] *Carib. For.* 4, 1943 (164–82); 5, 1943 (20–43). [F.e.span.] [Institut Botanique de France.]

The moss vegetation of the French Antilles shows a definite relationship to plant formations and clearly reflects the environment in which it develops. The article discusses the bryophytic formations found within the various plant associations, forest and other.

12.19.4. *Succession*

12.19.4 : 12.25–8. HUNT, K. W. **Floating mats on a southeastern coastal plain reservoir.** *Bull. Torrey bot. Cl.* 70, 1943 (481–8). [College of Charleston, Charleston, S. Carolina.] O.B.D.

Since the formation of the Goose Creek reservoir near Charleston, South Carolina, in 1903, a floating mat has developed and is already reaching the forest stage

of its succession. The pioneer zone, averaging about 50 ft. in width, merges into a cat-tail zone, 25 ft. to several hundred feet in width, followed by a narrow shrub zone of *Salix nigra* and *Myrica cerifera*. The main body of the floating mat displays a varied flora, including trees and shrubs with an undergrowth of several species of ferns and herbaceous flowering plants, usually growing upon a thick base of *Sphagnum*. *Acer rubrum* is of frequent occurrence, while *Persea pubescens* and *Taxodium distichum* occur more rarely. A list is given of 64 species of plants collected on the mat. An interesting fact is the absence of xeromorphic bog species. This is believed to be due to the permanent presence of actively circulating water of low acidity, whereas the comparatively motionless water of a bog tends to become highly acid.

12.19.4 (75.5–7) : 12.25 : 12.26–8 : 43 : 22.11. BARRETT, L. I. **Hardwood invasion in Pine forests of the Piedmont Plateau.** *J. agric. Res.* 67, 1943 (111–28). O.R.E.

A study was made of Shortleaf Pine (*Pinus echinata*) and Loblolly Pine (*P. taeda*) stands in the piedmont region of Virginia and the Carolinas in order to collect data in support of or against the hypothesis that extensive second-growth Pine forests in this area are beginning to revert to hardwoods. The random samples were confined to areas where Pine made up at least 90 per cent. of the overstorey stem count and where no burning or cutting had occurred within the previous five years. In the majority of the plots of both Shortleaf and Loblolly Pine the proportion of climax species (Oaks and Hickories) in the hardwood understoreys, as well as the total number of hardwoods per acre, increased with the age of the main Pine stand, provided that no burning had taken place during the preceding 10 years. In Shortleaf Pine stands the amount of Pine reproduction decreased significantly with the age of the overstorey, whereas under Loblolly Pine it tended to remain more or less constant for all ages of the overstorey.

In stands which had been burned at least once during the previous 10 years few significant relationships were discovered. From the results obtained it appears that fire is apparently favourable to the maintenance of Shortleaf Pine but unfavourable to that of Loblolly Pine. However, the fire histories of the stands examined were generally dissimilar, and the differences in fire effects may have been due primarily to such variations. There appeared to be no increase in the representation or numbers of Oaks and Hickories in the burned stands.

The implications of these results in forest management are considered, and the authors conclude that, except in special cases, clear-cutting will prove superior to selection cutting where maintenance of a high proportion of Pine is an objective of management.

12.19.4 (77.7) : 11.62.11 : 11.62.3 : 23.4 : 12.26–8. WARNER, R. M., and AIKMAN, J. M. **The relation of secondary plant succession to soil and water conservation.** *Iowa St. Coll. J. Sci.* 17, 1943 (175–89). [Iowa Agricultural Exp. Sta.]

This paper gives the results of a study of secondary plant succession in central Iowa with particular reference to the effect of the protective vegetative cover at each stage of the succession on soil and water conservation. The results showed that there was less relationship between the stage of development in the secondary succession and the rate of water loss than might have been expected, but the relationship between the stage of development and the rate of soil loss was well marked. The only anomalous fact in the series was the almost identical soil loss from the early and late weed stages. The greater soil-holding capacity of the fibrous root system of the bluegrass sod would seem to account for the smaller loss of soil from this site than from the Maple/Linden site where there was an absence of soil-holding plants at ground level. The loss of water from the bluegrass site, however, was definitely greater than from the forest site. In the forest, interception played a very important part, especially in the case of light rains.

Soil-building processes were very slow in the initial stages, but were accelerated as plants of higher stages in the succession gained control. The effect of plant cover in reducing water loss was less marked than its effect in reducing soil erosion. The introduction at an early stage of adaptable plants which normally occur later in the succession may accelerate the succession and increase soil and water conservation. Transplants of Green Ash, Black Locust and Siberian Pea were found to persist even on the steepest, driest sites of the early weed stage.

12.19.4 (79.6) : 11.33 : 11.11. DAUBENMIRE, R. F., and SLIPP, A. W. **Plant succession on talus slopes in northern Idaho as influenced by slope exposure.** *Bull. Torrey bot. Cl.* 70, 1943 (473–80). [Northern Rocky Mt. Forest and Range Exp. Sta.] O.B.D.

Observations were made on the vegetational types represented on two rock slides situated exactly opposite, about 300 m. down the slope on either side of the crest of an east-west ridge in northern Idaho. Marked differences occurred in the plant successions on the north and south slopes. In spite of the short distance separating the two talus areas the floras were almost entirely distinct. The type of vegetational development appears to be correlated with aspect. The relative dryness of the south slope is attributed primarily to the higher temperatures and to the scanty snow accumulation. The length of season when temperature is favourable for growth is such that soil moisture reserves are exhausted by the vegetation.

12.2. *Special* [*Systematic*] *Botany*

12.21. Fungi

12.21 : 12.19. BISBY, G. R. **Geographical distribution of fungi.** *Bot. Rev.* 9, 1943 (466–82). [Imperial Mycological Institute, Kew.]

The recognized species of phanerogams are believed to outnumber those of fungi by about five to one. Nevertheless, on account of their greater average range, the species of fungi are likely to outnumber those of phanerogams in any particular state or country. The smaller the area surveyed, the greater is the proportion of species of fungi to those of phanerogams. Saprophytic fungi generally have a wider distribution than the parasitic types, but the distribution of all fungi is primarily determined by that of their hosts and substrata. Other controlling factors are climate, the nature and density of phanerogams, light and length of season, and environmental disturbances, particularly those brought about by the activities of man.

12.21 : 44.3 : 12,25. NOBLES, M. K. **A contribution towards a clarification of the *Trametes serialis* complex.** *Repr.* from *Canad. J Res.* 21, 1943 (211–34).

The fungus frequently isolated from a destructive, brown, cubical rot in Sitka Spruce and Douglas Fir, and formerly referred to *Trametes serialis* Fries, has been connected with a fruit body collected on Sitka Spruce in the Queen Charlotte Islands, B.C. By means of morphological, cultural and interfertility studies it has been shown to be distinct from *Trametes serialis*, and is described herewith under the name *Poria microspora* Overholts, n. sp. Similar studies of *Poria sequoiae* Bonar, *Polyporus palustris* Berk., and *Poria carbonica* Overholts, n. sp., all of which have been confused with *Trametes serialis* because of similarities between fruit bodies or cultures, have demonstrated the validity of each of the species and have provided criteria for their separation on the basis of cultural characters. *Author's summary.*

12.21 (51) : 44.3 : 12.26–8. Wei, C. T. **Notes on Chinese fungi. X. Erysiphaceae of western Szechuan.** *Nanking J.* 11, 1942 (103–16). R.A.M. 22, 1943 (456).

These notes describe 22 species and varieties of Erysiphaceae collected in western Szechuan from 1938 to 1941 by the author and T. K. Zi. One new species and one new variety are described, and two new combinations proposed.

Ito and Hara [*Bot. Mag., Tokyo*, 29, 1915 (338)] erected the genus *Typhulochaeta* to accommodate a specimen occurring on *Quercus*, on the basis of what they regarded as a hitherto unrecorded type of appendage. The author finds that these are merely penicilliate cells, and true apical appendages. He therefore rejects the genus and renames the species *Erysiphe japonica* (Ito & Hara) Wei comb. nov. His specimens were collected on *Castanopsis* sp. and *Quercus aliena*.

The name *Uncinulopsis polychaeta* (B. & C.) Wei on *Celtis sinensis* is 're-established according to Article 54 of the International Rules for Botanical Nomenclature'. Full reasons for the change are not given.

Uncinula miyabei (Salm.) Sacc. var. *aleuritis* Wei var. nov. on *Aleurites fordii* differs from the type in having fewer appendages and larger asci (50·4 to 71·4 × 37·8 to 56 μ).

12.21 (74.8 : 76.8) : 44.3 : 31.42.1 : 12.25–8. Overholts, L. O. **Mycological notes for 1939–40.** *Mycologia* 35 (2), 1943 (243–54). R.A.M. 22, 1943 (454).

This annotated list of new and unusual fungi encountered during 1939 and 1940 includes *Poria cognata* n. sp. on a stump of Chestnut (*Castanea dentata*), Tennessee, *P. grandis* n. sp. on rotted conifer logs, Tennessee, *Beauveria globulifera*, found on a Locust in Pennsylvania, and *Stilbella acerina* n. sp. inhabiting spots on leaves of *Acer rubrum* in Tennessee in conjunction with *Phyllosticta acericola*.

12.25. Gymnosperms

12.25 : 01.2. Dayton, W. A. **The names of the Giant Sequoia.** *Leafl. West. Bot.* 3 (10), 1943 (209–19). Biol. Abstr. 17 (22280).

Statements from Californian botanists on either or both of two questions:—validity of the name *Sequoia gigantea* (Lindl.) Dec.; and segregation of the monotypic genus *Sequoiadendron* Buchholz.

12.25 : 21 : 23 : 24 : 56 : 31.0. Nascimento Ceccetta, G. O pinho brasileiro. [**The Brazilian Pine.**] Serviço de Informação Agrícola, Ministério da Agricultura, Rio de Janeiro. 1943. pp. 39. [Port.]

A short monograph of *Araucaria angustifolia*, dealing with the botanical characters, site requirements, cultivation, diameter and height growth, and utilization of this tree.

12.25 (72). Martínez, M. Una nueva especie de *Pinus* mexicano. [**A new species of *Pinus* from Mexico.**] *Madroño* 7, 1943 (4–8). [Span.e.] A.P.B.

The new species is *Pinus douglasiana*, a tree averaging about 20 m. tall and 30–35 cm. d.b.h., which occurs from Sinaloa to Oaxaca. It differs from *P. pseudostrobus* var. *tenuifolia* (Benth.) Shaw in its longer, stouter leaves and the larger apophyses of the cone scale.

12.26–8. Dicotyledons

12.26–8. De, R. N. ***Excoecaria aboriana* R.N. De sp. novo.** *Indian For.* 69. 1943 (395).

The new species is a small or medium-sized evergreen tree found in the Sadiya Frontier Tract. It differs from *Excoecaria oppositifolia* in certain leaf and flower characters and in its much larger fruit.

12.26–8. Dugand, A. Revalidacion de *Bombax ceiba* L. como especie tipica del genero *Bombax* y descripcion de Pseudobombax gen. nov. [**Revalidation of *Bombax ceiba* L. as the type species of the genus *Bombax* L., and a description of *Pseudobombax* gen. nov.**] *Caldasia* 6, 1943 (47–68). [Span.] [Inst. Cienc. Nat., Bogota Colombia.] Biol. Abstr. 17 (24683).

For historical reasons *Bombax* is to be typified by *B. ceiba* L., equivalent to *B. quinatum* Jacq. of Colombia rather than to *B. malabaricum* DC. of India as applied, and proposed as lectotype, by Hitchcock and Green in 1935. The genus is redefined, and *Pochota* Ramirez-Goyena and *Bombacopsis* Pittier placed in its synonymy. Synonymy is also given for *Bombax ceiba*, and collections are cited from Nicaragua to Venezuela. This typification of *Bombax* makes necessary for certain American trees hitherto placed in that genus the erection of a new genus *Pseudobombax* based on *P. septenatum* (*B. s.* Jacq.); *P. ellipticum* (*B. e.* H.B.K.); and *P. palmeri* (*B. p.* S. Wats.).

12.26–8. Howard, R. A. **Studies of the Icacinaceae—VI. *Irvingbaileya* and *Codiocarpus*, two new genera of the Icacinaceae.** *Brittonia* 5, 1943 (47–57). [Havard University.]

A study of species recently assigned to the genus *Medusanthera* (*Tylecarpus* of Engler and Sleumer) has revealed that they represent more than one generic entity. The author has therefore segregated the species *Tylecarpus merrittii*, *T. andamanicus* and *Medusanthera australis* into the new genera *Codiocarpus* and *Irvingbaileya* chiefly on account of the fruit structure, and, more especially, the form of the putamen. The essential generic differences are summarized in a synoptic key, and the new genera and combinations are described.

12.26–8 (410). Howard, A. L. **The Elm tree.** *Nature, Lond.* 152, 1943 (636–8).

A general discussion on *Ulmus* spp. (particularly *U. campestris* and *U. montana*) in Britain, including some early references to the genus both here and on the Continent, the uses of Elm timber, and the need for reforestation.

12.26–8. (410). Melville, R. **The British Elm flora.** *Nature, Lond.* 153, 1944 (198–9). [Royal Botanic Gardens, Kew.]

[Cf. preceding abstract.] While the Common or English Elm and the Wych Elm are undoubtedly the

most widely-distributed species of *Ulmus* in Britain, those parts of England lying to the south and east of a line drawn from the Bristol Channel to the Humber have an unusually rich Elm flora, including several species that appear to be endemic. Some of these species are named, together with several varieties and hybrids. It is suggested that the ill-repute of Elm as timber may be largely due to the acceptance by dealers of inferior hybrids as true *Ulmus* spp. Improved strains of timber, combined with resistance to Dutch Elm disease, may be obtainable by means of selective breeding. The Cornish Elm (*U. stricta*), the English Elm (*U. campestris*) and the Plot Elm (*U. plotii*) all appear to be comparatively resistant to Dutch Elm disease.

12.26–8 (72 : 728 : 729 : 8) : 12.19. KRUKOFF, B. A. **Supplementary notes on the American species of *Erythrina*—II.** *Bull. Torrey bot. Cl.* 70, 1943 (633–7). [New York Botanical Garden.] O.B.D.

Brief notes are given on 50 species of *Erythrina*. Extensions of range are noted for a number of species. No changes in nomenclature were found to be necessary.

12.26–8 (8). SMITH, A. C. **Studies of South American plants, X. Noteworthy Myristicaceae and Vacciniaceae.** *J. Arnold Arbor.* 24, 1943 (460–71). [Arnold Arboretum.]

Eleven new species are among the plants described. They include *Satyria arborea*, a tree up to 12 m. in height, closely allied to the recently described *S. allenii* from Panama [*Ann. Mo. bot. Gdn.* 28, 1941 (451)], and also resembling *S. breviflora* Hoer., from which, however, it differs in many details of foliage and inflorescence.

12.26–8 (81) : 21 : 24 : 33.38. Breves informacões sobre a *Piptadenia communis* ('Jacaré'). **[Brief information on *Piptadenia communis* (Jacaré).]** Serviço de Informação Agrícola, Ministério da Agricultura, Rio de Janeiro. 1943. pp. 8. [Port.]

Notes on the botanical characters, site requirements, and cultivation of *P. communis*, which is one of the most valuable trees in Brazil for the production of charcoal.

12.26–8 (82). TORTORELLI, L. A. Nueva variedad de *Schinopsis balansae*. **[New variety of *Schinopsis balansae*.]** *Rev. argent. Agron.* 10. 1943 (275–6 + plate). [Span.] A.P.B.

A brief description of *Schinopsis balansae* var. *pendula* nov. var. from material studied in the Argentine.

12.26–8 (932–9). SMITH, A. C. **Studies on Pacific Island plants—III. New and noteworthy flowering plants from Fiji.** *Bull. Torrey bot. Cl.* 70, 1943 (533–49). [Arnold Arboretum, Harvard Univ., Mass.] O.B.D.

The species discussed in this paper 'are either novelties, or represent range-extensions into Fiji, or are sufficiently unusual to merit notes'. Among the tree species dealt with are *Dacrydium lycopodioides* (35 m. high), *Celtis harperi* (4 m.), *C. vitiensis* sp. nov. (4 m.), *Degeneria vitiensis* (18 m.), *Polyalthia angustifolia* sp. nov., *Xylopia pacifica* sp. nov. (6 m.), *Samanea saman*, *Albizzia lebbeck*, *Acacia farnesiana* (4 m.), *Aglaia parksii* sp. nov. (5 m.), *Allophylus sublaxus*, *A. umbrinus* sp. nov. (small tree), *Rhamnella vitiensis* (3 m.), *Colubrina papuana* (13 m.), *Barringtonia petiolata* (13 m.), *Discocalyx sylvestris* sp. nov. (10 m.), *Rapanea crassiramea* sp. nov., *Linociera gillespiei* sp. nov., and *L. vitiensis* sp. nov. (5 m.).

12.26–8 (95). MERRILL, E. D., and PERRY, L. M. **Plantae Papuanae Archboldianae, XIII. Melastomataceae.** *J. Arnold Arbor.* 24, 1943 (422–39). [Arnold Arboretum.]

This study of the Melastomataceae, as represented by material from New Guinea and the Solomon Islands, follows the basic work of Mansfeld [*Bot. Jb.* 60, 1925 (105–43)]. Among the new species recorded are the following trees:—*Astronidium novo-guineense*, *A. insulare*, *A. montanum*, *A. salomonense*, *A. sessilifolium*, *A. anomalum*, and *Memecylon papuanum*.

13.1. *General Zoology*

13.15 : 13.2 : 12.19.2–3. OSBORN, B. **Wildlife and habitats in Young County, Texas, by a new method of survey.** *J. Wildlife Mgmt.* 7, 1943 (241–56). [U.S. Soil Conservation Service, Glen Rose, Texas.] B.A.P.

The data obtained from an August survey of wildlife and habitats in Young County, Texas, were based on the following four main land types:—(1) Timbered streambanks and bottoms (originally supporting Elms (*Ulmus*) as the predominating species); (2) brushy Post Oak land (originally covered with *Quercus stellata* mixed with shrubs such as *Rhus trilobata*, and species of *Smilax*, *Xanthoxylum* and *Forestiera*); (3) open Post Oak land (originally covered with open stands of Post Oak with few or no shrubs and a continuous undercover of prairie grasses); and (4) prairie land with or without scattered trees of *Quercus virginiana* or *Prosopis chilensis*. Fifty species of birds and mammals were recorded from the 58 sample areas. The cottontail (*Sylvilagus floridanus*) was the most abundant animal recorded, being present in 88 per cent. of the plots, including all the timbered streambanks and brushy Oak areas. The mourning dove (*Zenaidura macroura*) was present in 68 per cent. of the plots. Tables are given showing the habitat conditions and the species and percentage frequency of wildlife recorded in the various areas.

13.15 : 13.2 : 12.19. COLQUHOUN, M. K., and MORLEY, A. **Vertical zonation in woodland bird communities.** *J. Anim. Ecol.* 12, 1943 (75–81).

A study was made of the relative vertical niche of occurrence in the vegetation of a *Quercus robur* wood near Oxford of the common bird species during the non-breeding season. Sample counts of birds were recorded from five zones:—(1) the upper canopy (above 35 ft.), (2) the tree zone (15–35 ft.), (3) the shrub zone (4–15 ft.), (4) the herb zone (3 in.–4 ft.), and (5) the ground zone. The vertical distribution and relative abundance of each species is shown diagrammatically. The tree and shrub community is the most important of the communities recorded. Each zone has a different numerically dominant species:—the wood pigeon dominates the upper canopy, the blue tit the tree zone, the great tit the shrub zone, the wren the herb zone, and the blackbird the ground zone.

13.15 : 13.2. ENE, I.-M. Experimentalurersuchungen über das Verhalten des Maikäferengerlings (*Melolontha* spec.). **[Experimental investigations on the larvae of *Melolontha melolontha* and *M. hippocastani*.]** *Z. angew. Ent.* 29, 1942 (529–600). [G.] R.A.E. 31A, 1943 (450–1).

A detailed account is given of laboratory and field observations in Prussia on the seasonal migrations of

cockchafer (*Melolontha melolontha* and *M. hippocastani*) larvae in the soil. The ascent of the larvae in spring was stimulated by warmth, and the rate at which it proceeded varied with temperature, but was greater after March than earlier in the year. Migration occurred normally in soil with humidity of 6–9 per cent., but in completely dry sand only some of the larger larvae were able to ascend. Lack of food after hibernation also stimulated the ascent, and under these conditions the larger larvae sometimes ate the smaller ones.

Daily variations in temperature during the vegetation period did not influence the depth at which the larvae occurred, but they descended to greater depths if the soil moisture fell below 3 per cent. They were killed by flooding if completely surrounded by water for at least four days.

The autumn descent was stimulated by cold and was most rapid after October. The depth at which hibernation took place depended largely on temperature and the nature of the soil.

13.15 : 13.2 : 45.3 : 12.26–8. HAVILAND, E. E. **Hibernation and survival of the Locust leaf-miner.** *J. econ. Ent.* 36, 1943 (639–40). [University of Maryland, College Park.]

The Locust leaf-miner, *Chalepus dorsalis*, hibernates between fallen deciduous leaves. It shows a preference for thick, undisturbed masses of undisintegrated leaves (particularly those of Maple and the narrower types of Oak leaves) on well-drained slopes. It appears to hibernate close to Locust trees if suitable conditions are available.

Tests with beetles placed in wire screen cages containing Oak and Maple leaves between December 1st and January 4th, showed survival rates between 88·23 and 92·27 per cent. in the spring.

13.15 : 13.2 : 45.3 : 12.25. JAHN, E. Untersuchungen über die Arthropodenfauna von Tannenbeständen und ihre Empfindlichkeit gegen Insektizide. [**Investigations on the arthropod fauna of Fir stands and their sensitivity to insecticides.**] *Cbl. gesamte Forstw.* 68, 1942 (151–72). [G.g.] [Institut für Forstentomologie und Forstschutz der Hochschule für Bodenkultur in Wien.]

Data were obtained at Wischau near Blumenau during tests on the control of *Cacoecia murinana*. The arthropod fauna encountered and their sensitivity to different insecticides are noted in a table. Pyrethrum × Derris and Detal, both contact poisons supplied by the firm 'Merck', killed large numbers of various insect groups. Spiders proved to be completely resistant to these and the other poisons used.

13.15 : 13.2 : 45.3 : 12.25. STURM, H. Untersuchungen über Buschhornblattwespen (*Diprion*). [**Investigations on Diprionine sawflies.**] *Z. angew. Ent.* 29 (3/4), 1942 (412–42). [G.] R.A.E. 31A, 1943 (449–50).

The numerous observations recorded in this paper were made in Pine stands in Mecklenburg in 1937–40, largely by means of an outdoor insectary and cages fixed to the trees, and the results are compared with those of other workers. The species observed were *Diprion similis*, Htg., *D. pini*, L., *Gilpinia* (*D.*) *pallida*, Klug, *G.* (*D.*) *socia*, Klug, *G.* (*D.*) *virens*, Klug, *G.* (*D.*) *frutetorum*, F., *G.* (*D.*) *laricis* var. *fenestrata*, Ensl., *G.* (*D.*) *variegata*, Htg., *Neodiprion* (*D.*) *sertifer*, Geoffr., and *Macrodiprion* (*D.*) *nemoralis*, Ensl. That studied in greatest detail was *D. similis*, which is considered to be characteristic of the group.

Natural enemies of the various stages of the sawflies are also discussed at some length.

13.15–9 : 13.2 : 45.3 : 12.26–8. CHAMBERLIN, T. R., FLUKE, C. L., and CALLENBACH, J. A. **Species, distribution, flight and host preferences of June beetles, in Wisconsin.** *J. econ. Ent.* 36, 1943 (674–80).

A study of the June beetles (*Phyllophaga* spp.) of Wisconsin, their host preferences, flight habits, and the possibilities of their control. Shrub Hazel, Bur Oak and Hickory are of particular importance as food plants for these insects. *Phyllophaga rugosa*, *P. fusca*, and *P. futilis* were found on a variety of hosts (10, 8, and 12 principal hosts, respectively), so that control of these species by spraying or dusting presents serious difficulties. Control should be less difficult in the case of *P. hirticula*, *P. tristis*, *P. implicata*, and *P. ilicis*, which tend to concentrate their feeding on a few species of plants. *P. rugosa*, *P. hirticula*, and *P. fusca* comprised 87·93 per cent. of the beetles collected.

13.19 : 13.2 : 45.3 : 12.25. PFEFFER, A. Příspěvek ku poznání rozšíření některých lýkožroutů v Čechách a na Moravě. [[**On the distribution of several species of *Ips* in Bohemia and Moravia.**] *Lesnická Práce* 21 (11/12), 1942 (447–62). Biol. Abstr. 17 (25400).

Ips typographus, *I. amitinus*, and *I. cembrae*, primary pests of Spruce.

13.2. *Special* [*Systematic*] *Zoology*

13.2 (410). EMDEN, F. I. VAN. **Larvae of British beetles. IV. Various small families.** *Ent. mon. Mag.* 79, 1943 (209–16, 217–23, 259–64, 265–70). [Imperial Institute of Entomology.]

13.2 (42.1–8). AIRY SHAW, H. K. **Some recent additions to the list of Gloucestershire Hemiptera-Heteroptera.** *Ent. mon. Mag.* 80, 1944 (18–9).

Among the ten records given are *Metatropis rufescens* from Hazel, and *Megacoelum beckeri* from *Pinus sylvestris*. As the elytra of the latter insects are pale, not dark, it is possible that the form collected from the Pines is var. *lethierryi*. It appears to be a spreading species.

13.2 (42.1–8). DICKER, G. H. L. **Additions to the Oxfordshire list of Coleoptera.** *Ent. mon. Mag.* 80, 1944 (13). [East Malling Research Sta., Kent.]

The following species new to Oxfordshire are recorded:—*Lycoperdina bovistae* (found among leaves and dead wood), *Odontaeus armiger* (swept from herbage in a young plantation), *Cassida fastuosa*, *Otiorrhynchus raucus*, *Balaninus cerasorum* (on Birch), *Melasis buprestoides* (on dead branches of Wild Cherry), *Phymatodes testaceus* (bred from larvae collected under the bark of a felled Oak), and *Phytoecia cylindrica*.

13.2 (42.1–8) : 23.3 : 12.25. WALSH, G. B. ***Asemum striatum* L. (Col. Cerambycidae) in Yorkshire.** *Ent. mon. Mag.* 80, 1944 (22).

Arsemum striatum is reported to have been collected during felling operations in a dale north of Wykeham, near Scarborough. Its gradual spread over the rest of the country is to be expected as one of the results of afforestation with conifers.

13.2 (66.7) : 45.3 : 12.26–8. CHINA, W. E. **A new genus and species of Miridae (Bryocorinae) feeding on *Khaya grandifolia* in the Gold Coast (Hemiptera Heteroptera).** ***Bull. ent. Res.* 34, 1943 (287–90).**

The new genus, *Boxia*, is allied to *Sahbergella*, Hagl. A description is given of this genus and of the type species, *Boxia khayae*.

13.2 (71.3–7) : 13.15 : 45.3 : 12.25. ATWOOD, C. E., and PECK, O. **Some native sawflies of the genus *Neodiprion* attacking Pines in eastern Canada.** *Canad. J. Res.* 21, Sec. D, 1943 (109–44). I.M.I.

In eastern Canada sawflies of at least twelve species of the genus *Neodiprion* have been causing damage to White, Red and Jack Pine through eating the needles. Keys are given for the determination of adult females of 11 species and of larvae of 10 species. Two of the species are described as new. The sawflies can be distinguished also by their habits, notably those of oviposition, feeding, and overwintering.

13.2 (79.1) : 13.15 : 12.26–8. FUNKHOUSER, W. D. **Two new Membracidae from Arizona.** *Bull. Brooklyn ent. Soc.* (*n.s.*) 38, 1943 (75–7). I.I.E.

The two new species, *Stictolobus viridis* and *Xantholobus arizonensis*, were collected in May, 1942, in an Oak forest (*Quercus emoryi* and *Q. gambeli*) at an elevation of about 5,000 ft. in the Santa Rita Mountains 41 miles south of Tucson, Arizona. The species are described.

13.2 (94) : 31.43. NIXON, G. E. J. **New Braconid parasites of the Australian wood-boring beetles with notes on the subfamily Hecabolinae (Hym., Braconidae).** *Bull. ent. Res.* 34, 1943 (257–67). [Imperial Institute of Entomology.]

One new species in the Doryctinae and six (including one new genus) in the Hecabolinae are described. The new genus is *Terate*, of which the type species is *Terate menopon* sp. n. Some remarks are included on the status of the subfamily Hecabolinae.

2. SILVICULTURE

2 : 12.25 : 60.31.2 : 12.19 : 43. BULL, H., and REYNOLDS, R. R. **Management of Loblolly Pine. Further study needed.** *J. For.* 41, 1943 (722–6). [Southern Forest Exp. Sta., New Orleans, La.]

2 : 12.25 : 60.31.2 : 12.19 : 43. CHAPMAN, H. H. **[Management of Loblolly Pine.] Common sense needed.** *J. For.* 41, 1943 (726–7). [Yale University, New Haven, Conn.]

2 : 12.25 : 60.31.2 : 12.19 : 43. PEARSON, G. A. **[Management of Loblolly Pine.] Intensive forestry needed.** *J. For.* 41, 1943 (727–9). [Southwestern Forest and Range Exp. Sta., Tucson, Ariz.]

Comments are made on the bulletin 'Management of Loblolly Pine in the Pine-hardwood region in Arkansas and in Louisiana west of the Mississippi River' by H. H. Chapman [cf. *For. Abstr.* 4 (224)].

21. SILVICULTURAL CHARACTERS OF TREE SPECIES

21 : 12.25 (43.1–5) : 56 : 12.11.3 : 23.21. ZIMMERLE. Beiträge zur Biologie der europäischen Lärche in Württemberg. **[Contributions to the biology of European Larch in Württemberg.]** *Mitt. württemberg. forstl. Versuchsanst.* 1941 (7–206) [G.] *Abstr.* in *Forschungsdienst* (*Schrifttum*) 15, 1943 (20). [G.] A.P.B.

According to 1927 figures, Larch occurs on only 0·2 per cent. of the forested area of Germany. Yield data are given for European Larch (*Larix decidua*) on the basis of investigations in Württemberg stands.

As a result of investigations on the provenance of Larch seed used in Württemberg, as well as on the performance of various species and races of Larch in comparable experiments, the use of Japanese Larch (*L. leptolepis*) is recommended for damp sites and Sudeten Larch is preferable elsewhere.

21.2. *Moisture Requirements. Water Régime*

21.2 : 11.41.3. FEHÉR, D. Recherches sur le besoin en eau statique des arbres forestiers. **[Research on the static water requirements of forest trees.]** *Intersylva* 2, 1942 (461–71). [F.g.e.span.ital.] [Institut botanique de l'Université Royale Hongroise de Sciences Techniques et Économiques, Sopron.]

A report of an investigation on the influence of heat and moisture on the life of the forest. Experiments to date on a large number of tree species indicate that for the majority there is, at least during the early years of their growth, a definite optimum proportion of air and water in the soil. In general, the optimum water content corresponds to a 70–90 per cent. of the water capacity in a given soil.

21.3. *Soil Requirements.*

21.3 (94) : 11.47 : 11.42.2 : 11.44 : 23.21 : 23.24 : 23.26. KESSELL, S. L. **The nutrition of the forest crop.** *Aust. For.* 7, 1943 (4–21).

This paper reviews the information at present available on a number of problems of fundamental importance to the silviculture of Australian forests, both indigenous and exotic. It is emphasized that sound forest management requires not only a knowledge of silvicultural technique but also the fullest possible information on all factors that influence the growth and condition of trees, based on study of the sciences involved and on adequate field experiments in which the action and interaction of all environmental factors are considered.

It is pointed out that whereas the deciduous tree species of Europe and North America are generally considered to play an important part in determining the character of soil types, Australian experience indicates that Eucalypts are not of importance in this respect and that soil requirements of these species are relatively low: species of *Eucalyptus* will grow to heights of over 250 ft. on soils too low in essential plant nutrients to support a stand of *Pinus radiata*.

A characteristic feature of European forests is the maintenance of a more or less closed canopy resulting in a shaded, relatively humid condition on the forest floor which favours the freeing of humus nitrogen by nitrification. In contrast, the Eucalypt forests, in regions of low summer rainfall, cast little shade, the leaf litter is completely dry for many months of the year, and no mould is formed, yet many such forests show a relatively high annual volume increment. Investigations of soils in the southwest of Western Australia show that they have a considerable capacity for producing nitrogen during the period of active tree growth; a minimum concentration of nitrate nitrogen has been recorded throughout the year in virgin forest soils and it is concluded that this forest, with its undergrowth, has become adapted to absorb practically all the available nitrogen.

It appears that in the forests of southern Australia and similar climatic zones, the principal role of leaf litter, which is very rapidly decomposed, is to supply essential minerals such as potassium, calcium and magnesium.

From the evidence available it appears that in general forest soils, whether in tropical or in sub-tropical regions, are not harmed by very occasional burning, while frequent fires have an adverse effect on the physical but not necessarily on the chemical properties of the surface soil. However, in Western Australia young Pines that are planted on certain soils within a few months following a single heavy slash burn appear to be more susceptible to a disorder known as rosetting than do Pines planted on unburned areas.

Soils under Jarrah (*Eucalyptus marginata*) showed a marked improvement in physical condition following complete fire protection for a period of 8–12 years.

Success in introducing exotic tree species depends primarily on accuracy of judgment in selecting and correlating site and species. A standard of site quality commonly in use is the height of the indigenous forest crop; as a guide to site selection for exotics this factor may prove definitely misleading in southern Australia where first-class Eucalypt forests grow to a great height on soils poor in plant nutrients. Furthermore, the successful growth of exotic Pines on farm land is no indication that the same species will grow successfully on unimproved land of a similar soil type. Past cultivation and manurial treatment of the farm land benefit the Pine, which have the majority of their feeding roots associated with mycorrhiza near the soil surface.

While chemical analyses of soils are generally of little value except as an indication of relative fertility, it has been found that figures relating to certain elements may have some index value if applied within a definite range as regards climate and tree species. Thus in the southwest of Western Australia total P_2O_5 content has proved to be a useful indicator of site quality for different species of Pine, although later investigations suggest that available rather than total P_2O_5 is a more reliable indicator, particularly if pasture land is being considered.

Chemical analysis of plant tissue is of little practical value for indicating the relative nutrient requirements of the plant.

No satisfactory method has yet been found to counteract the depreciation in fertility of nursery soils that have been used for growing successive crops of seedlings in southern and Western Australia. Reference is made to Australian work on the mycorrhizal association between Pine roots and fungi in exotic plantations, and to the use of manures and other soil treatments that are of commercial importance in promoting the growth and well-being of Western Australian Pine plantations on poor soil types.

21.32 : 23.27 : 42.5. CHADWICK, L. C. **Diagnosis of nutritional requirements of ornamental plants.** *Amer. Nurserym.* 78 (7), 1943 (8–11).

The extreme deficiency symptoms displayed by plants grown experimentally in cultures entirely lacking in one or more nutrient elements are often misleading to one who grows plants under field conditions where essential elements are seldom totally lacking, but where any given element may be present in insufficient amounts or, although present, may not be readily available to the plant. The various elements necessary for healthy growth are reviewed briefly. A chart of plant nutrient deficiency symptoms, and a key to such deficiency symptoms as may apply to woody plants are appended.

21.6. *Behaviour in the Stand*

21.61 : 12.14.3 : 21.2–3 : 12.25. KALELA, E. **The relation of the roots of Pine seedlings to those of mother trees.** *Acta for. fenn.* 50 (17), 1942 (1–12). [Finn.g.] S.P.S.

On poor soils, where there is strong competition for nutrients and soil moisture, it has been found that the roots of Pine seedlings avoid the neighbourhood of the roots of older trees, particularly if the older trees are growing vigorously.

21.61 : 12.14.4 : 12.25–8 : 11.12. TISCHENDORF, W. Über Gesetzmässigkeit und Ursache der Exzentrizität von Baumquerflächen. **[On the general tendencies and the cause of eccentricity in cross sections of trees.]** *Cbl. gesamte Forstw.* 69, 1943 (33–54). [G.g.]

From a study of the various theories on this subject and from his own investigations in Spruce, Silver Fir, Scots Pine, and Beech stands, the writer suggests that eccentricity in cross sections of tree stems is correlated with a unilateral development of the crown, which, in turn, is conditioned mainly by the mechanical and physiological action of wind. The direction of the greater diameter of eccentric cross sections tends to coincide with the direction of the prevailing wind. However, various modifying factors (direction of the sun, the slope, etc.) may affect crown development and hence affect the eccentricity of cross sections of stems.

21.61 : 12.14.6 : 12.26–8 : 21.32. MØLLER, C. M. Askens Form. **[The form of the Ash.]** *Dansk Skovforen. Tidsskr.* 1941 (1–35). [Dan.] S.P.S.

Although young Ash trees usually grow straight, older trees often have wide crowns and are bushy, even in dense stands. This is generally believed to be caused by insects damaging the terminal bud. The author states that the terminal bud will be poorly developed if the soil contains too little phosphoric acid in comparison with the available nitrogen.

21.61 : 12.26–8 : 12.11.22 : 23.27. MILNE, M. J. **Fastigiate trees.** With discussion. *Proc. 18th nat. Shade Tree Conf.* 1942 (96–103).

The characteristics and advantages of fastigiate trees are outlined. Among the desirable features of such trees are the slow diameter growth of their trunk and branches, the rare occurrence of butt swell, and the narrow crown and restricted root system which allow grass and other plants to grow beneath the tree and cause a minimum of interference with sewers, sidewalks and street lighting. The author states that fastigiate varieties are less costly to maintain than the species. They are particularly suitable for (1) planting in certain localities, as in narrow streets and in commercial centres, (2) windbreaks and screens, (3) small city lots, and (4) formal locations such as bridge approaches, building entrances, etc. Budding is a cheaper method of propagation than grafting and requires less experience. Budded Elms may grow up to 6 ft. the first year. Fastigiate varieties of Poplar, Willow, Plane and Linden are best grown from cuttings.

21.64 : 56.01 : 22.89 : 12.25–8 : 11.14.3 : 21.0. MINCKLER, L. S. **Effect of rainfall and site factors on the growth and survival of young forest plantations.** *J. For.* 41, 1943 (829–33). [Appalachian Forest Exp. Sta., Asheville, N.C.]

This paper presents in detail the 3-year history of 499 experimental plantings of Shortleaf Pine (*Pinus echinata*), White Pine (*P. strobus*), Yellow Poplar (*Liriodendron tulipifera*), Black Walnut (*Juglans nigra*), White Ash (*Fraxinus americana*) and Red Gum (*Liquidambar styraciflua*) on old fields in eastern Tennessee. Differences in rainfall, particularly during the first growing season, and in site factors are shown to have a marked effect on height growth and survival, with considerable variation between species.

21.9. *Longevity*

21.9 : 12.25 (72). RICKETT, H. W. **The big tree of Tule.** *J. N.Y. Bot. Gdn.* 44, 1943 (269–73).

A popular account of a large Cypress (*Taxodium mucronatum*), over 150 ft. in girth, situated in the churchyard of the village of Tule in southern Mexico. Some observers believe that the giant tree consists of several individuals joined together. Its age is uncertain. Professor C. Conzatti has published a 54-page booklet entitled 'Monografía del Arbol de Santa María del Tule' on the results of his investigations into the botany, ecology, age, and historical and literary associations of this tree. [*Publ. Secr. Ed. Publ., Oaxaca* 6 (4), 1925 (1–54).]

22. SILVICULTURAL SYSTEMS. FORMS OF STAND

22 : 21 : 11. PEARSON, G. A. **How local is silviculture?** *J. For.* 41, 1943 (917–9). [Southwestern Forest and Range Exp. Sta.]

The writer points out the need for basing silviculture on a sound understanding of the environmental factors, their inter-dependence, and the modifying effects of competition. On such a basis silviculture becomes essentially a uniform practice irrespective of geography, variations in detail being necessary only in the sense that different adjustments are made to bring about proper coordination between heat, light and moisture.

22.1. *High Forest Forms*

22.14.1 : 12.25. BORNEBUSCH, C. H. Hugst fra Toppen i Rødgran. [**Selection cutting in Spruce stands.**] *Dansk Skovforen. Tidsskr.* 1941 (400–406). [Dan.] S.P.S.

Selection cutting usually means that the largest trees are cut; great care is necessary in this operation and in practice not all the big trees need be taken in the first cutting but only those of relatively poor quality.

22.14.2 : 12.25 : 24.36. PEARSON, G. A. **The facts behind improvement selection.** *J. For.* 41, 1943 (740–52). [Southwestern Forest and Range Exp. Sta.]

Periodic measurements of individual Ponderosa Pine, growing under various conditions on a cut-over area, have shown that the growth of individual trees is determined not so much by the size of crown as by the space available for root expansion. These findings form the basis of marking practice under the method of improvement selection [cf. *For. Abstr.* 4 (228).] In selecting trees that are to remain in the stand under this method, consideration is given first to the quality of the bole, second to the spacing, and third to the crown.

The present article discusses the application of improvement selection to stands of Ponderosa Pine of known growth record and representing three distinct age classes.

22.14.2 : 12.26–8 (74.8) : 56.04. HOUGH, A. F. **Methods of harvesting sawtimber from forests in the high plateaus section of Pennsylvania.** *J. For.* 41, 1943 (898–903). [Allegheny Forest Exp. Sta.]

Studies of the factors affecting the periodic annual increment of saw timber in the northern hardwood type following cutting operations, made on cut-over areas and permanent sample plots, indicate the importance of leaving an adequate residual growing stock. Silvicultural practice in northern hardwood stands which takes the form of a partial cutting, leaving a fairly good growing stock of desirable species and quality, will give the best possible volume production at a high growth rate and will aid in producing sawlogs of good quality.

22.14.2 : 12.26–8 : 56.05 : 98.1. STOTT, C. B. **Increasing production of critical lumber grades by selective cutting.** *J. For.* 41, 1943 (734–9).

Methods of selection cutting used in the old-growth, northern hardwood forest that favour the removal of trees of high quality and above the average size are shown to be more efficient than clear cutting in making available certain lumber grades and products that are in great demand at the present time. Comparable results in lumber grade recovery following clear cutting and two methods of selection cutting are discussed. Important commercial species in the northern hardwood forest include Beech, Maple, Birch, Elm, and Ash.

22.2. *Coppice Forest*

22.22 : 12.26–8 : 12.14.7. ALLARD, H. A. **Fruiting sprouts of Chestnut Oak.** *J. For.* 41, 1943 (768). [U.S. Bureau of Plant Industry.]

The one-year-old sprouts, bearing what appeared to be normal acorns, were found to be growing from the base of an 11-in. Chestnut Oak (*Quercus montana*) that had been severely injured by fire the previous year.

22.8. *Silvicultural Description of Forms of Stand*

22.83 : 12.25 : 12.26–8 : 11.47.2. WIEDEMANN, E. **Der gleichaltrige Fichten-Buchen-Mischbestand.** [**The mixed, even-aged Spruce-Beech stand.**] *Mitt. Forstwirt. Forstwiss.* 13 (1) [1942?]. pp. 88. [G.] *Abstr.* in *Forschungsdienst* (*Schrifttum*) 15, 1943 (20). [G.] A.P.B.

In order to determine the value of introducing Beech into pure Spruce stands for the purpose of maintaining soil fertility, the author made a survey of the results from numerous mixed stands in central and northern Germany, which had been under observation over a long period. It was found that where both the Spruce and Beech were even-aged the mixture demanded only a small sacrifice in increment, as compared with pure Spruce; in such cases the mixture is definitely recommended. On soils that tend to compact and acidify the proportion of Spruce should be reduced, this species being replaced in part by Larch. Beech should not be used on sites that are unfavourable to this species; here pure Spruce stands are established and soil fertility is maintained by artificial measures, such as liming.

22.89 : 12.25 (82). SCHNABEL, P. **Repoblación forestal en el territorio de Misiones.** [**Afforestation in the Misiones region.**] *Publ. misc. Minist. Agric. Argentina* No. 72, 1940. pp. 8. [Span.]

Report on a few small plantations of *Araucaria angustifolia*, which have been successfully established since 1930.

23. FORMATION OF STANDS

23–4 : 12.25 (494). OBERLI, H. Bericht über die Reise zum Studium des Anbaus der Lärche ausserhalb ihres natürlichen Verbreitungsgebietes, veranstaltet von der Eidgenössichen Inspektion für Forstwesen, Jagd und Fischerei. **[Report on the tour for the study of the cultivation of Larch [in Switzerland] outside its natural range, organized by the Federal Inspectorate for Forestry, Game and Fishery.]** *Schweiz. Z. Forstw.* 93, 1942 (313–29 + plates). [G.g.]

23–4 : 12.26–8 (85) : 24. CUSTODIO, T. El cultivo del mimbre. **[Cultivation of the Willow.]** *Circ. Minist. Fomento Dir. Agric. y Ganaderia, Peru.* No. 60, 1942 (1–7 + plate). [Span.] [Est. Exp. Agric., La Molina.] Biol. Abstr. 17 (25012).

Methods of propagating and cultivating various species of *Salix* are described with reference to their usefulness under Peruvian conditions.

23–4 : 12.26–8 (89). GUERREROS, J. A. Los Eucalyptos: su cultivo. **[The Eucalypts: their cultivation.]** *Agric. Com. Ind., Paraguay* No. 4, 1941 (51–6). [Span.]

Notes on the technique of growing Eucalypts under Paraguayan conditions. There are some 20 species in the country, the more important being *E. citriodora*, *E. globulus*, *E. rostrata*, *E. paniculata*, *E. diversicolor*, *E. tereticornis*, *E. amigdalina*, *E. stuarthiana*, *E. resinifera*, *E. amplifolia*, and *E. goniocalix*.

23–4 : 12.26–8 (81). VIANNA, E. F. Breves instruções sobre a cultura da bracatinga. **[Brief instructions for the cultivation of Bracatinga.]** Serviço de Informaçõa Agrícola, Ministério da Agricultura [Rio de Janeiro]. [1943?] pp. 2. [Port.]

Notes on the cultivation of Bracatinga (*Mimosa scabrella* and *M. bracatinga*) under Brazilian conditions.

23–4 : 12.26–8 (81) : 31.0. GEHLSEN, C. A. Erfahrungen mit dem Anbau von Eukalyptus in Brasilien. **[Experiences with regard to the cultivation of Eucalypts in Brazil.]** *Mitt. Kolonialforstw.* 5 (1), 1942 (45–62). [G.] *Abstr.* in *Forschungsdienst* (*Schrifttum*) 15, 1943 (16). A.P.B.

The author reports on experiences in the establishment, cultivation, reproduction and uses of Eucalypts in Brazil.

23.1. *Natural Regeneration*

23.1′ : 12.26–8 (43.7) : 56. Forstliche Ausbreitung der Eschenkultur in der Slowakei. **[Extension of Ash cultivation in Slovakia.]** *Int. Holzmarkt* No. 51/52, 1941 (28). [G.] *Abstr.* in *Z. Weltforstwirt.* 9, 1942 (466–7). [G.]

Since the abolition of clear fellings, Ash is increasing in abundance in Slovakia. It regenerates freely in Beech/Ash stands and the growth rate is fast.

23.1–2 (485) : 12.25 : 23.23.1. TIRÉN, L. Skogsodling i Norrlands granskogar. **[Regeneration in the Spruce forests of Norrland.]** *Skogen* 29, 1942 (231–2). [Sw.]

Investigations that have been carried out by the State Forestry Research Institute in the Norrland Spruce forests in West Bothnia, Västernorrland and parts of Jämtland, show that while natural regeneration is frequently satisfactory at elevations up to 100–150 m., particularly where cutting is properly managed, at higher elevations the conditions are often unfavourable and regeneration is poor. Here artificial regeneration should be undertaken on a large scale.

For this purpose seed is required at an early date, in large quantities and at a reasonable price. Old forests in Norrland are not characterized by abundant seed production; and experience with Pine indicates that seed should not be imported from the south of the country or from lower altitudes. Therefore when there is an abundant harvest of Spruce cones at higher altitudes (as in 1942), they should be collected and samples of seed should be sent to the State Seed Central Station for germination tests. Germination requirements for seed from high altitudes should not be too exacting. R. P. J.

23.2. *Artificial Regeneration*

23.2 : 12.25 : 42.21 : 23.5 : 12.26–8. MULTAMÄKI, S. E. **[Sowing and planting Spruce on moorland.]** *Acta for. fenn.* 47 (3), 1940 (1–132). [Finn.g.] S.P.S.

Experiments in establishing Spruce seedlings on moorland included:—(*a*) broadcast seeding; (*b*) sowing of 30–40 seeds on up-turned turfs 0·3 m. × 0·4 m.; and (*c*) planting on up-turned turfs. Results showed that plants from broadcast seeding were least damaged by climatic conditions, those from the seed spots were damaged by frost heaving in winter and dry weather in summer, and those developing from planted seedlings were more sensitive to frost damage than the other plants.

It was found that by spreading a layer of litter on the surface of the moor, heat radiation from the soil was diminished thus raising the lower limit of soil temperature. Shelter from trees also had a beneficial effect on regeneration, Birch being the most suitable species for this purpose. Therefore, the recommended method for the regeneration of Spruce on moorland is broadcast seeding under a cover of Birch.

23.2 : 12.26–8 : 12.11.3. JOHNSSON, H. Poppelkulturer —Intryck från en studieresa till Belgien och synpunkter på poppel i svensk skogsbruk. **[Poplar plantations: impressions from a study tour to Belgium and views on the Poplar in Swedish forestry.]** *Svensk PappTidn.* No. 9, 1943 (208–14). [Sw.] Plant Breed. Abstr. 14 (322).

Various aspects of Poplar cultivation are discussed. Poplar breeding on a large scale is in progress at Ekebo, and types suitable for the conditions of the country are expected to be produced relatively soon. Cultivation problems relating to soils, spacing and interplanting are included in the work of the Swedish Association for Forest Tree Breeding.

23.21. Choice of Species

23.21 : 12.25 : 21.3. INDIANA. **Fifty-fourth annual report of Purdue University Agricultural Experiment Station, Lafayette, Indiana, for the year ending June 30, 1941.** Purdue University Agricultural Exper. Sta. [1941.] pp. 114.

Chinese Aborvitae (*Thuja orientalis*) is reported to be the least difficult to grow of all the species used in the experiment station nursery; it is adaptable to a variety of soil and growing conditions (p. 75).

23.21 (485) : 12.26–8 : 21.3 : 21.12 : 23.26. DANNFELT, M. J. Rödeken som skogsträd i Sydsverige. **[The Red Oak as a forest tree in south Sweden.]** *Skogsägaren* 19, 1943 (26–9). [Sw.]

One of the exotic broadleaved trees from North America that does not appear to have suffered injury

during the last few severe winters is the Red Oak (*Quercus borealis*), which has been planted in various parts of Sweden from Scania up to Bergslagen. This species is characterized by properties which under certain conditions make it of greater silvicultural value than the indigenous Oak, and it deserves to be used more extensively. *Q. borealis* is now planted on a large scale in Holland, Germany and Denmark, often in mixture with *Q. borealis maxima*, *Q. coccinea* and *Q. palustris*.

Experience hitherto in Scania as well as in Denmark and Germany indicates that *Q. borealis* is very slightly susceptible to autumn frost and certainly sensitive to spring frost, but not more so than the indigenous Oak. It is less exacting than the Swedish Oak in soil requirements and thrives even on poor sandy soil, but does not grow well on acid or shallow soils. It has a marked capacity for improving soil conditions and is more resistant than the indigenous species to attack by mildew and insects.

On poor sandy soils in the most southerly part of Sweden Spruce and Pine are so badly affected by root rot that a change to broadleaved species will become necessary sooner or later. Beech and European Oak cannot be grown on these poor soils and a pure Birch stand will not usually give a satisfactory yield. Red Oak should be a useful species on such sites.

Measurements of a 30-year-old stand of Swedish Oak and a 25-year-old stand of Red Oak at Bormholm have shown that the latter species has attained considerably larger dimensions and up to the present has given a higher total yield and a larger profit from thinning.

The timber of Red Oak is slightly inferior to that of Swedish Oak in hardness but superior to it in elasticity and toughness.

In propagating Red Oak the dry acorns should be soaked in water for two days before sowing in drills 1 dm. deep in early spring. In transplanting the following spring the plants are spaced 0·5 m. apart in rows 1 m. apart. If cleaning and thinning of young stands is properly done the trees will prune themselves satisfactorily. R. P. J.

23.21 (489) : 12.25–8 : 12.11.3. SYRACH LARSEN, C. Erfaringer med udenlandske Traearter i dansk Skovbrug. **[Experience with exotic tree species in Danish forestry.]** *Svenska SkogsvFören. Tidskr.* 41,1943 (166–99). [Dan.]

From the beginning of the nineteenth century up to the present time the forested area of Denmark has increased from 4 per cent. to 8·2 per cent. of the total land area. This has been due largely to the planting of heathland and 'klit' (downs). The annual increment has been doubled in the last 50 years and the annual yield of usable timber has increased from 50,000 cu. m. to 500,000 cu. m. This improvement has been achieved mainly through the wider use of exotic conifers.

The only conifers that are indigenous to Denmark are the Juniper (*Juniperus communis*) and the Yew (*Taxus bacatta*). It is believed that Scots Pine (*Pinus sylvestris*) was once native to the country, but it had become extinct, perhaps with the exception of a few single trees, when it was reintroduced in the eighteenth century. The coniferous forest area to-day consists of approximately 45 per cent. Mountain Pine (*Pinus montana*), 50 per cent. Norway Spruce (*Picea abies*), and 5 per cent. of species such as Larch (*Larix decidua*), Sitka Spruce (*Picea sitchensis*), and Douglas Fir (*Pseudotsuga taxifolia*). Mountain Pine has been widely used because of its well-known value as a pioneer on heathland (*Calluna vulgaris*) where its presence makes conditions more favourable for the establishment and growth of Norway Spruce.

Hardwoods consist mainly of Beech with some Oak and a little Ash, Elm and Alder. The total area of hardwood has not changed greatly, but on a percentage basis it has decreased considerably as the newer plantations are principally of coniferous species.

The oldest living exotic in Denmark to-day is a Chestnut (*Castanea sativa*), planted in 1699. Single trees of Silver Fir are believed to have been planted as early as 1666. Conifers (Norway Spruce and Scots Pine) were first introduced on a large scale in 1730 with the object of stabilizing sand dunes on the coast.

About 1800 many new species were brought to Denmark by traders, mainly from eastern North America. These included *Pinus strobus* (now mostly destroyed by blister rust), *Tsuga canadensis*, *Thuja occidentalis* and several hardwoods. The trees were planted in parks for amenity purposes but they were the vanguard to large-scale afforestation with exotics.

The fast-growing conifers from western North America, including Sitka Spruce, Douglas Fir, *Abies nobilis*, *A. amabilis*, *Chamaecyparis* spp., *Sequoia gigantea*, etc., were first introduced about 1850. Douglas Fir is the most widely used of these species and useful amounts of home-produced seed are now being obtained from stands planted about 1878. Recently Sitka Spruce has become a serious competitor of Douglas Fir as it shows equally fast growth, has greater resistance to wind, and appears to grow well even on poor soil *Abies grandis* and *Tsuga heterophylla* are also promising on the more sheltered sites.

On the heathland the main species are Mountain Pine and Norway Spruce, while in the many miles of shelterbelts throughout Jutland White Spruce (*Picea glauca*) is by far the most common species intermixed with some Sitka Spruce.

Corsican Pine (*Pinus laricio*) has increased in popularity in recent years despite the fact that some time ago it was thought to be highly susceptible to *Lophodermium*. It is planted on the chalk downs and near the coast where it has proved resistant to salt-water spray. *Pinus contorta* and *P. murrayana* are also used to some extent in exposed sites but they do not appear to thrive. *P. murrayana* is the better of the two but they are both attacked by *Tortrix buoliana* with the consequent deformation of the stem.

Silver Fir (*Abies alba*), one of the first species to be introduced into Denmark, is still of importance although it is rather badly attacked by *Chermes*. *A. nordmanniana* from the Caucasus is used to some extent, especially as it is more resistant to spring frost than is *A. alba*. Hybrids between *A. alba* and *A. nordmanniana* are known to occur. *A. balsamea* grows well on heathland but has very limited use as it is heavily attacked by *Trametes pini*. *A. grandis* is the most promising of the true Firs, being generally healthy and showing vigorous growth. It is found scattered throughout the country but has not as yet been used in large-scale afforestation owing to difficulties in obtaining seed.

European Larch (*Larix decidua*) is common in mixture with hardwoods, particularly in Beech woods, where it makes up a considerable proportion of the total timber value. It is seldom successful in pure

stands because of the prevalence of canker. Unfortunately Denmark did not import at an early date the high-quality Scottish strain of European Larch. Japanese Larch (*L. leptolepis*) is promising, with quick growth even on light soil, and is suitable for planting with Oak as protection against night frost. The hybrid between European and Japanese Larch is gaining in popularity, and first-generation hybrids between Eastern Siberian Larch (*L. dahurica*) and Japanese Larch have shown remarkable growth (heterosis).

The most valuable of the more recent exotics is probably the green variety of Douglas Fir; the blue variety is slow-growing and is heavily attacked by *Rhabdocline pseudotsugae*. A dangerous pest of the green variety in recent years has been the rust fungus *Phaeocryptopus gäumanni*, although the author is of the opinion that this disease is not serious enough to affect the use of the species. Douglas Fir is growing well even on poor soil, but it does require shelter.

Hemlock (*Tsuga heterophylla*) is not much used in Denmark. Although it will grow relatively well on poor soil and acid heath there is too much wind for the species to thrive.

Of other conifers, *Thuja plicata* is the only one of some interest. It shows fairly good growth and, because of its durability, the wood is used in the construction of glasshouses.

No exotic hardwoods have been able to compete with the native species of Oak, Beech, Ash, etc. The American Red Oak (*Quercus borealis* var. *maxima*) may have a future in Danish forestry; although the wood is considered to be slightly inferior in quality to that of *Q. pedunculata*, it is of value in its tolerance of local climatic conditions and in its ability to grow well on poor soil.

Tree Breeding.

A good start has been made with tree breeding in Denmark. Flower twigs from older selected individuals of various species have been grafted on younger trees for breeding purposes: in the arboretum at Hörsholm 68 Larches, 5–6 years old, have yielded 3,805 cones with ¾ kg. of seed from grafted twigs (1943).

Numerous experiments are being undertaken in interspecific hybridization. Crosses that have been made include *Picea sitchensis* × *P. glauca*, *Larix decidua* × *L. occidentalis*, and *L. leptolepis* × *L. gmelini dahurica*. Artificial seed production and seed selection are aimed at developing strains having certain desirable qualities such as disease resistance, e.g. the use of seed resulting from a cross of two healthy Douglas Fir located in a stand that is heavily attacked by *Phaeocryptopus gäumanni*. FINN FROST.

23.21 : 23.27 : 91.4. BOERNER, A. L. **Selection of plants for city conditions—recreational forestry areas and other definite uses.** *Proc. 18th nat. Shade Tree Conf.* 1942 (92–6). [Regional Planning Department, Milwaukee, Wisconsin.]

According to the author, the choice of species for ornamental plantings under city conditions should be based upon the ecological association of plants native to the district, preference being given in most cases to native rather than to exotic trees. An attempt should be made to reproduce as far as possible the conditions of environment found in the natural habitat. Species differ considerably in their adaptability to changed site conditions. Notes are given on a number of native trees with reference to their suitability for use in city areas.

23.21–2 : 22.82–3 : 23.2 (43.1–5). VOGDT, O. Wiederherstellung standortsgemässer Mischbestände an Stelle von Kiefernreinbeständen im Forstamt Zollbrücken. **[Restoration of mixed stands adapted to the site in place of pure Scots Pine stands in the Zollbrücken forest district.]** *Forstarchiv* 18, 1942 (128–36). [G.]

An attempt to replace the pure Pine stands of the Zollbrücken district of northern Silesia with suitable mixed stands was begun in 1924. Conditions for the introduction of new species were not particularly favourable: in this district rainfall is scanty and the soil is only moderately suitable. Important factors in successful plant introduction are protection against any agencies that cause direct damage to the plants or deprive them of water or nourishment, and include protection from frost and from the root competition of grasses and older, more tolerant species. Careful spacing and thinning, and, where necessary, the digging of the seedbed, will add to the chances of success. In general, the poorer the site the greater is the space required per plant.

The author discusses the various difficulties encountered in bringing about a change of composition in the Zollbrücken woodlands. He indicates the methods of afforestation used and the results achieved. Beech and Sessile Oak are two of the principal introduced species. The latter generally grows better than Beech on dry soils, but a mixture of the two species is recommended.

23.22. Preparatory Work. Auxiliary Measures

23.22.1 (485) : 11.44. BROMEE, F. Om tekniken vid hyggesbranning. **[The technique of burning clear-cut areas for regeneration.]** *Norrlands SkogsvFörb. Tidskr.* 1942 (401–53). [Sw.] S.P.S.

Large areas in northern Sweden are covered with a thick layer of raw humus which has to be partially decomposed before tree growth is possible. In many cases burning is necessary to accelerate this process, even on cleared areas. This paper gives information on methods of organizing and carrying out burning operations in order to get the best results and to avoid risk of forest fires.

23.22.1 (485) : 24.1 : 24.51 : 64. SJÖSTRÖM, H. Norrländska röjningsproblem samt grönkvistning som hjälpmedel i hygges- och ungskogsvården. **[Cleaning problems in Norrland and the pruning of young forest stands.]** *Norrlands SkogsvFörb. Tidskr.* 1940 (89–136). [Sw.] S.P.S.

In northern Sweden there are large areas of cut-over land that should be brought into a productive state as soon as possible. The necessary measures for site preparation as well as early cultural operations in the young stands will vary with local conditions and can best be determined on the basis of forest types, judged by ground vegetation. Early pruning is recommended as a means for improving wood quality.

23.22.2 (66.9) : 91.1 : 23.24 : 23.21. CLARKE-BUTLER-COLE, R. F. **Forest farming (*taungya* plantations) in Benin.** *Farm and Forest* 4, 1943 (103–15).

An agreement was made with the Benin Native Authority in 1935 that, in addition to the forest reserves already in existence, a further 1,000 sq. miles of reserves should be established in the Benin Division, the planting to be done by the *taungya* system at the

rate of 1,000 acres annually. The conditions necessary for the successful introduction of *taungya* on a large scale appear in general to be fulfilled in Benin.

This article discusses the progress that has been made with the scheme thus far, some of the problems involved, and the silvicultural requirements of the tree species being used, particularly as these affect planting practice. At present a spacing of 16½ ft. × 16½ ft. has been adopted for many plantations; it is hoped to eliminate all thinnings and finally to have at least 10 mature trees per acre. It is pointed out that the present technique is still in the process of evolution and more research is required before it can be standardized.

23.23. Sowings

23.23.1. *Seed Procurement, Treatment, and Testing*

23.23.1 (4) : 12.11.3 LANGNER, W. Le probleme des races forestières dans la forêt européenne. **[The problem of forest tree race in European forests.]** *Intersylva* 2, 1942 (479–88). [F.g.e.span.ital.] [Reichsforstamt, Berlin.]

The author suggests origin certification of tree seed on an inter-European basis, following the German model [cf. *For. Abstr.* 2 (272–4)]. The principles of certification should be worked out jointly by the European States and their application supervised by the forest authorities in each country.

23.23.11 : 12.25 : 12.11.3 : 22.89. JENSEN, H. Plantagemässig produktion av högvärdigt skogsfrö. **[Production of high-grade forest-tree seed in plantations.]** *Skogen* 30, 1943 (53–6). [Sw.]

Proposals are made to meet the urgent demand in Sweden for an increase in the future output of high quality timber. Full details are given of (1) the method of establishing and maintaining regional plantations for the production of high-grade seed from élite trees of superior genotype in the different climatic areas of the country; and (2) the author's preliminary work in establishing model seed plantations for Pine and Spruce in Sweden and his preparations for a similar programme for other important trees.

The need for wide co-operation by the state and other forest owners, for scientific and technical control and for an advisory organization is stressed. M. L. C. W.

23.23.11 : 12.26–8 : 11.47.13. DETWILER, S. B. **Better acorns from a heavily fertilized White Oak tree.** *J. For.* 41, 1943 (915–6). [U.S. Soil Conservation Service.]

Following a heavy application in 1941 of a high-nitrogen fertilizer, at the rate of over 14,000 lb. per acre, to the soil under a single White Oak (*Quercus alba*) about 50 ft. high and 23 in. d.b.h., the acorn production increased from 2 bushels in 1939 to more than 8 bushels in 1942. Acorns of the latter crop showed a relatively high germination capacity and vigour in becoming established and surviving under unfavourable conditions.

23.23.13 : 12.25 : 23.23.19. KANGAS, E. **The influence of the drying kiln on the extraction and germination of Pine seeds.** *Acta for. fenn.* 50 (14), 1942 (1–42). [Finn.g.] S.P.S.

Experiments in seed extraction were undertaken at kiln temperatures of 30°, 40°, 50°, 60°, and 70° C. and at 20° room temperature. While speed of extraction and quantity of seed increased directly with temperature, germination per cent. of the seed decreased, and it is suggested that in extracting Pine seed the kiln temperature should not exceed 50° C.

23.23.14 (44) : 12.11.3. HESS, E. Waldsamen von bekannter Herkunft. **[Forest tree seeds of known provenance.]** *Schweiz. Z. Forstw.* 94, 1943 (91–3). [G.]

It is reported that origin certification in the trade with forest tree seed and plants has been made compulsory in France under a decree of June, 1942. Control is vested in the forest authorities.

23.23.14 (489) : 12.11.3. BORNEBUSCH, C. H. Die Kontrolle der Samen- und Pflanzenherkunft in Dänemark. **[The control of the provenance of seeds and plants in Denmark.]** *Schweiz. Z. Forstw.* 94, 1943 (288–90). [G.] [Staatliches forstliches Versuchswesen, Springforbi, Dänemark.]

An outline of the voluntary control system operated by the Seed Committee of the Danish Forest Society [cf. *For. Abstr.* 2 (274).]

23.23.15 : 12.25. MILLER, H. W., and LEMMON, P. E. **Processing cones of Ponderosa Pine to extract, dewing, and clean the seed.** *J. For.* 41, 1943 (889–94). [Soil Conservation Service, Pullman, Washington.]

A new process for extracting seed from cones of Ponderosa Pine, which makes use of a medium sized swinging-hammer type mill and an ordinary seed cleaner, is described. Factors that have proved to be of importance to the process are:—(1) moisture content of cones, (2) mill speed, (3) rate of feeding, and (4) size of screen used in the mill. The advantages of this method over those ordinarily used are:—(1) cones can be collected and processed before natural opening has resulted in loss of seed; (2) only small amounts of concentrated materials need be transported and handled after the initial steps (milling and scalping) are completed at the collecting site; (3) expensive equipment such as kilns, drying sheds, and special cleaning and dewinging equipment are unnecessary.

23.23.19 : 12.25 : 12.11.11 : 12.14.7. ROHMEDER, E. Beeinflusst der Vitamin-C-Gehalt der Nadelholzsamen das Färbungsergebnis des Natriumselenitverfahrens? **[Does the vitamin C content of coniferous seeds influence the colour reaction in the sodium selenite process?]** *Forstwiss. Cbl.* 65, 1943 (65–70). [G.g.] [Universität München.]

The vitamin C content of the seed of Spruce and Pine amounts at most to 5 milligrams per 100 grams and, being so low, has no effect whatever on the colour reaction in the selenium method of testing the viability of seed. [Cf. *For. Abstr.* 1 (120).]

23.23.19 : 12.25 (485) : 11.32–3. TIRÉN, L. Granföets grobarhet i Norrland. Preliminärt meddelande. **[Viability of Spruce seed in Norrland. Preliminary communication.]** *Skogen* 30, 1943 (4–5). [Sw.]

In October 1942, under the direction of the Forestry Board, extensive germination tests were carried out on samples of Spruce seed collected from various parts of Sweden. Percentage germination after 10 days proved to be higher than expected after an unfavourable summer. On the basis of the data obtained from these tests, recommendations are made with respect to the altitudinal limits up to which cones can be collected in different regions of the country from south to north. Near these limits in areas north of lat. 64° N. seed from stands with south or west exposure have higher viability than those from stands on north or east slopes.

R. P. J.

23.23.19 : 12.26–8. India and Burma. **Forest research in India and Burma, 1941–42. Part 1.—The Forest Research Institute.** Forest Research Institute, Dehra Dun. [1943?] pp. 151 + plates.

Seeds of *Terminalia chebula* 0·4–0·6 in. in diameter are shown to have given a significantly higher germination per cent. than seeds of larger diameter (pp. 27–8).

23.23.3. *Methods of Sowing*

23.23.3. Flodman, B. Ruthackning och sådd med såddkanna. **[Seed-spot sowing—a study of methods.]** *Norrlands SkogsvFörb. Tidskr.* 1942 (376–93). [Sw.] S.P.S.

An analysis of the work involved and of the time required for each operation.

23.23.3 : 12.26–8 (66.9). MacDonald, K. R. **Notes on ridge sowing.** *Farm and Forest* 4, 1943 (141–2).

On heavy, badly-drained soils, well-cultivated ridges with a broad base, not less than 12 in. high, and with rounded or flattened tops, have been used successfully as a 'dry' nursery for the production of seedlings of *Cassia siamea*, *Jacaranda mimosaefolia* and *Khaya senegalensis*. It is proposed to experiment with this method as a direct anti-erosion measure.

23.24. Formation of Stands by Planting

23.24.2. *Methods of Planting*

23.24.2 (481) : 12.25. Mork, E. Om plantemetoder. **[Methods of planting.]** *Skogsägaren* 19, 1943 (29–30). [Sw.]

In commenting on a recent article by Heikinheimo on planting studies in Finland the author states that according to Norwegian experience, shallow root planting of Spruce has given best results and is not more costly than other methods. One man, using a light mattock, does both digging and planting and an experienced worker sets out about 300 plants per day. [Cf. *For. Abstr.* 5 (178).] R. P. J.

23.24.3. *Spacing*

23.24.3 : 56.05 : 12.25 : 33.32. Klem, G. G. **Effect of planting space on the quality of Spruce wood and sulphite pulp.** *Medd. norske Skogforsøksv.* No. 28 [Vol. 8, No. 2]. 1942 (257–93). [Nor.e.] S.P.S.

Material for the study was obtained from five pure Spruce stands, 31–39 years of age, of the same good site quality, in which planting distances had been 1·25, 1·50, 2·00, 2·50, and 3·50 meters, respectively. Results showed that for planting distances up to 2·5 m. there was little difference in yield of pulp by weight, or in tensile or bursting strength. Tearing strength of the pulp decreased as the planting distance increased from the minimum to the maximum. On the basis of this work a planting distance of 1·50–1·70 m. is recommended for Spruce in the lowlands.

23.24.3 (66.9). Fairbairn, W. A. **Espacement of plantation species: Plateau Province.** *Farm and Forest* 4, 1943 (139–41).

The need for factual information on the proper espacements following planting and thinning of different species is indicated. Experiments to be made in Plateau Province, Nigeria, for studying different planting espacements are outlined.

23.26. Plant Rearing. Nursery Practice

23.26.3 : 23.27. Halter, E. T. **Tree moving practices in the south.** *Proc. 5th Sth. Shade Tree Conf.* 1942 (264–7).

Experience in moving trees in the Southern States has shown that, while some species can be moved successfully bare-rooted, others require that a ball of earth containing most of the roots be taken. A relatively small number, including *Simaruba glauca*, cannot be moved with success by any method or under any conditions.

In most cases it is possible to move trees with the greater part of their foliage intact, but a few species must be defoliated, and others require to be severely pruned or cut back. Two of the main causes of the failure of transplanted trees are (1) the constant breakage of new roots caused by the swaying of insecurely-rooted trees, and (2) the presence of air pockets under the roots, especially in sandy soils. A large ball of earth on transplants materially reduces swaying, and the puddling of trees two or three times within a week or two after planting will help to prevent air pockets.

23.26.4 : 12.25. Indiana. **Fifty-fourth annual report of Purdue University Agricultural Experiment Station, Lafayette, Indiana, for the year ending June 30, 1941.** Purdue University Agricultural Exper. Sta. [1941.] pp. 114.

Survival of small 2-year-old seedlings of *Pinus sylvestris* and *P. resinosa* was much improved by cultivation (pp. 75–6).

23.26.4 : 12.25 : 12.26–8 : 11.41.1 : 11.47.1. Aaltonen, V. T. **Experiments in the growing of forest tree seedlings.** *Acta for. fenn.* No. 50, 1942. S.P.S.

Studies were made of the germination and early growth of seedlings of Pine, Spruce and Birch at different soil temperatures and with various fertilizer treatments.

23.26.4 : 34.6. Turk, L. M. **The effect of sawdust on plant growth.** *Quart. Bull. Mich. agric. Exp. Sta.* 26 (1), 1943 (10–22).

Mainly from the results of experiments described in this paper it is concluded that:—(1) Sawdust, whether used as a mulch or mixed with the soil, depresses the yield of non-leguminous crops, the depressive effect being of a temporary nature and closely associated with a decrease in available nitrates. (2) The addition of sawdust to the soil will have no harmful effects if it is supplemented with some readily available source of nitrogen. For soils deficient in nitrogen this should be added in sufficient quantities to give the sawdust the equivalent of about 2 per cent. nitrogen. (3) Sawdust is a very effective absorbent of liquid manure but does not have the capacity to fix or absorb ammonia nitrogen. (4) Sawdust has little fertilizing value, the plant nutrient supply and availability both being low. (5) The chief benefit of sawdust, either when mixed with the soil or used as a mulch, is of a physical nature: it tends to loosen heavy soils, and increases the water-holding capacity of heavy soils and sands, thus decreasing losses due to water erosion. (6) When applied as a mulch the chief function of sawdust is to protect the moist soil from the sun and wind.

23.27. Arboriculture

23.27. Eggers, E. R. **Inarching—bridge-grafting—topworking.** *Proc. 9th West. Shade Tree Conf.* 1942 (371–6). [Univ. of California, Los Angeles.]

A description is given of the technique employed in inarching and bridge-grafting operations as applied to shade tree maintenance, and reference is also made to

the less frequent practice of topworking. Inarching and bridge-grafting are most commonly employed to save trees wholly or partially girdled by mechanical means.

23.27. FELT, E. P. **Shelter trees in war and peace.** Orange Judd Publishing Co., New York. 1943. pp. 320. Biol. Abstr. 17 (20703).

Many shelter trees that have been injured by construction work can be saved at a cost much less than that of replacement. The purpose of this book is to show how this can be done and how provision can be made for such trees for the future. Some of the chapters are:—Construction work and its effect on trees; Trunk and branch troubles; Dangers to the foliage canopy or leaves; General care of trees; Selection of shelter trees. Chapter 16—'Shelter or shade trees of the U.S.' consists of 115 pages of notes on about 300 species of native and exotic trees grown in the U.S.A.

23.27 : 21.2. KIMBALL, M. H. **Irrigation of ornamental trees.** *Proc. 9th West. Shade Tree Conf.* 1942 (334–9).

23.27 (73). SCANLON, E. H. **Some factors in the planning and management of public trees.** *Proc. 9th West. Shade Tree Conf.* 1942 (348–57).

The planning and management of city street trees is basically a business proposition undertaken to increase real estate values. To accomplish this it is necessary that the Park Superintendent or City Arborist should be given absolute control of the planting, maintenance and removal of street trees, and that he should construct a master street plan built around (*a*) considerations for the planting and treatment of each street, and (*b*) a detailed compilation of each individual tree, its location, species and condition. A list is given of the local site factors which should be considered before fitting a tree to a street.

Heavy maintenance costs may be due to faults arising from the too close spacing of certain street trees. Planting distance should vary according to the species used; in the case of trees requiring very wide spacings, interplanting with shrubs or shorter-lived species is recommended.

A scheme of zoning is proposed in order that the types of tree selected may conform as far as possible with the changing character of a street, but as a certain amount of uniformity is also essential, there must be designated a minimum area or number of blocks (2 to 4 in most cases) that can be planted at one time, excepting, of course, replacements. Good equipment, trained men, the adoption of improved methods, and the setting up of research projects, will all contribute to successful management.

23.27 : 74. WHITNALL, G. **Commercial values of public trees.** *Proc. 9th West. Shade Tree Conf.* 1942 (308–19).

23.3. *Afforestation*

23.3 : 11.62.11 : 23.21 : 12.25–8 : 45.12. BAUER. Die Flugsandaufforstungen in Marchfeld. [**Afforestation of shifting sands in the Marchfeld region.**] *D. Gebirgsforst, Wien* 23 (2), 1941 (31–3). [G.] *Abstr.* in *Forschungsdienst* (*Schrifttum*) 15, 1943 (58). A.P.B.

In the fertile Marchfeld region situated to the east of Vienna there is a strip of land, 30 km. by 10 km., in which the soil consists of boulders and shifting sand. Both the steppe and the sand are arid and practically devoid of humus. The steppe occurs where the sand has been loosely bound together by masses of *Stipa pennata*. Juniper up to 5 m. in height is a pioneer species in controlling the sand movements, but it is now being replaced by more useful species, namely, *Pinus laricio* (75 per cent.), *P. sylvestris* (15 per cent.), *Robinia pseudoacacia* (8 per cent.), and *Alnus incana*, *Betula*, and other broadleaf trees (2 per cent.). Up to 1937, 770 ha. had been afforested, but 560 ha. have yet to be planted. Rabbits, which breed in the Juniper thickets, are being successfully controlled by fencing.

23.3 (46) : 23.21 : 12.25 : 12.26–8 : 21.61 : 44.3 : 12.21. DENGLER, A. Über Aufforstungen in Nordspanien. [**On afforestation in northern Spain.**] *Z. Weltforstwirt.* 9, 1942 (434–46). [G.e.f.]

In the past 20–30 years, extensive afforestation work has been carried out along the Bay of Biscay and in the adjoining mountain districts. The principal species are *Pinus insignis* and *Eucalyptus globulus*, both of which show remarkably fast growth. The Eucalypts are very straight and thin-branched. The Insignis Pine tends to develop thick branches, which may prove a difficulty when the timber is used for pulp wood, and, since the fast-grown wood has a low strength, the trees are easily damaged by storm and during felling operations. The Pine plantations have been subject to attacks by *Lophodermium pinastri* and *Hylobius abietis*. As Pine afforestation progresses, the organization of fire protection becomes essential. This, it is suggested, should be directed by the State.

24. TENDING OF STANDS AND TREES

24.2. *Thinnings*

24.2. WELANDER, P. O. Gallring med uttagande företrädesvis av de grövre eller av de klenare stammarna i beståndet? [**Shall thinning preferably remove the larger or the smaller trees in the stand?**] *Norrlands SkogsvFörb. Tidskr.* 1940 (197–222). [Sw.] S.P.S.

Three types of thinning may be distinguished:—(*a*) low thinning—the average diameter of trees removed is smaller than that of remaining trees; (*b*) crown thinning—the average diameter of trees removed equals that of the remaining trees; (*c*) selection thinning—the average diameter of trees removed is larger than that of remaining trees.

The author does not favour selection thinning as he believes it will expose the residual stand to storm damage and cause a reduction in volume and value production. Figures are presented in support of these views.

24.2 : 12.25 : 63. GRØN, A. H. Tyndningshustens Økonomi ved Rødgrandyrkning i Danmark. [**The economy of thinning in Spruce forest in Denmark.**] *Dansk Skovforen. Tidsskr.* 1940 (353–413). [Dan.] S.P.S.

Basing his calculation on Møller's yield tables, which have three site classes and represent a forest that is thinned according to a standard grade, the author develops the possibilities of two additional thinning schedules for each site class, one 30 per cent. heavier and one 30 per cent. lighter than the standard grade. The relative merits of the different thinning schedules are considered with reference to influence on average diameter, distribution of size classes as related to price scales and market requirements, etc., and it is concluded

that heavy thinnings in combination with a long rotation will give the best results.

24.21 : 12.26–8. Bornebusch, C. H. Udhuggningens Betydning for Bøgeskovens Udformning och dens Vaerditilvaekst. **[The importance of thinning in Beech forest.]** *Dansk Skovforen. Tidsskr.* 1940 (261–320). [Dan.] S.P.S.

The author discusses a sample-plot study of the effect of thinning on Beech. The importance of tree selection is emphasized. Stand density should be such as to favour the development of straight boles with small branches, and thinnings should aim at removing inferior trees and at the same time improving conditions for the better trees.

24.25 : 12.25 : 22.89 : 56. Mulloy, G. A. **Growth of Red Pine plantations under management.** *Silvic. Leafl. Dom. For. Serv.* 17, 1943. pp. [2].

Cf. *For. Abstr.* 1 (266–7). Measurements made five years after thinning a Red Pine (*Pinus resinosa*) plantation (24 years old at time of thinning) show that current annual increment of merchantable material (8 in. d.b.h. and up) is 684 cu. ft. per acre on the thinned stand and 340 cu. ft. per acre on the unthinned stand. The average height of the stand has increased by 10 ft. in the five-year period.

24.25 : 57 : 22.82.1. Vanselow, K. Über die Ursachen der annähernd gleichen Massenleistung unserer Reinbestände bei verschiedener Durchforstung. **[On the causes of the approximately equal volume yield of our pure stands with various types of thinning.]** *Forstwiss. Cbl.* 65, 1943 (1–13). [G.]

Almost all long-term thinning investigations to date have shown that the total volume production of even-aged pure stands is approximately equal for moderate and heavy low thinning and moderate high thinning. Various explanations have been put forward; the author favours the 'translocation theory', which maintains that the stand tends towards a certain optimum production which is maintained by the residual stand after a number of the trees have been removed.

24.3. *Opening of the Canopy. Release and Improvement Fellings*

24.31. Bavngaard, A. A. Vanris på Eg. **[Water sprouts on Oak.]** *Dansk Skovforen. Tidsskr.* 1941 (389–99). [Dan.] S.P.S.

Water sprouts are killed, and there is little danger of their recurring, if treated with a 4-per-cent. aqueous solution of $NaClO_3$. The treatment should not be applied to trees without a well developed cork bark. The solution is inflammable.

24.31. Long, H. K. **Eradicating weed trees.** *E. Afr. agric. J.* 9, 1943 (123).

The writer reports success in eradicating weed trees by using a 5-per-cent. solution of sodium arsenite (four parts white arsenic and one part caustic soda) injected into the tree by means of a simple tree-stabbing tool that has been developed by the Forestry Department of Cornell University, New York.

24.31 : 12.26–8 : 12.25 (76.4) : 97.3. Bell, H. M., and Dyksterhuis, E. J. **Fighting the Mesquite and Cedar invasion on Texas ranges.** *Soil Conserv.* 9, 1943 (111–4).

The gradual invasion of vast areas of Texas ranges by Cedar (*Juniperus* spp.) and Mesquite (*Prosopis* spp.) at the expense of the grass cover has resulted in a substantial lowering of the State's potential meat production. It is estimated that the cattle-carrying capacity of the Mesquite-covered area could be increased from about 2,368,421 to 3,750,000 if the Mesquite were replaced by an average stocking of forage plants; while the Cedar area, which now supports about 125,000 head of cattle could be made to support 260,870 head by the removal of the Cedars. Eradication is, however, difficult (especially in the case of Mesquite), and the increased returns per acre for one year would not nearly cover the cost involved for a given area. However, increased returns over a period of years would eventually make eradication worth while.

Practical instructions are given for the clearing of Cedar and Mesquite from range areas, and for the restoration of such areas to good pasturage.

24.4. *Shelterbelts. Windbreaks*

24.4 : 23.21 : 12.25–8 : 21.3. Steavenson, H. A., Gearhart, H. E., and Curtis, R. L. **Living fences and supplies of fence posts.** *J. Wildlife Mgmt.* 7, 1943 (257–61 + plate). [U.S. Soil Conservation Service, Milwaukee, Wis.] B.A.P.

Some of the advantages of living hedges as opposed to wire fences are pointed out. Observations in Illinois suggest that insect damage is definitely reduced in areas where shelter exists for birds and parasitic insects. Formerly Osage Orange (*Maclura pomifera*) was the principal species used in fencing the prairies, and many data support the view that the beneficial effects of tall-growing Osage as a windbreak will offset the apparent sapping effect of the trees on crop yield. From the point of view of erosion control, plant barriers are also more satisfactory than wire fencing. The Asiatic Rose, *Rosa multiflora*, although an exotic species, shows the greatest promise of fulfilling the requirements of a living fence. It has excellent cover qualities, produces quantities of fruit which persist during the winter and serve as a food reserve for birds, while in survival and growth performance it compares favourably with any other shrub tried in Missouri or Illinois. In addition, it is less subject to leaf disease than the native *Rosa setigera*. Red Cedar (*Juniperus virginiana*) has also been used with success as a living fence. Thrifty hedgerows of this species may become a profitable farm crop. Data from several hedge-post harvests in northern Missouri showed a close correlation between the yield of posts and firewood and the character of the subsoil. Large yields were generally obtained from soils with a porous, friable, well-oxidized subsoil.

24.4 (78.3–7) : 23.6 : 11.47 : 12.26–8. George, E. J. **Effects of cultivation and number of rows on survival and growth of trees in farm windbreaks on the northern Great Plains.** *J. For.* 41, 1943 (820–8). [Northern Great Plains Field Station, Mandan, N.D.]

Investigations made to determine the best methods of growing windbreaks under conditions of limited moisture supply have shown that:—(1) Survival, height growth and crown spread of the trees within the windbreak were greatest where the windbreak had been cultivated until a complete crown cover was established, thus reducing competition from weeds and sods. (2) Relatively narrow windbreaks, of not more than 6 to 8 rows, were more effective than wider ones in making use of snow drifts as a supplementary supply of

water beyond that afforded by the annual precipitation.

Green Ash (*Fraxinus pennsylvanica* var. *lanceolata*) was the tree species selected for this study.

24.4 : 12.26–8. INDIANA. **Fifty-fourth annual report of Purdue University Agricultural Experiment Station, Lafayette, Indiana, for the year ending June 30, 1941.** Purdue Univ. Agricultural Exper. Sta. [1941]. pp. 114.

Willow windbreaks have been found to be effective generally in reducing wind velocity below the minimum (12 miles per hour) at which losses in soil and crops take place (p. 76).

24.5. *Pruning*

24.51 : 12.25 : 56.02. INDIA and BURMA. **Forest research in India and Burma, 1941–42. Part 1.—The Forest Research Institute,** Forest Research Institute, Dehra Dun. [1943?] pp. 151 + plates.

While pruning of saplings of *Pinus longifolia* up to one-third and two-thirds of the height of the plants had no significant effect on height growth in comparison with unpruned controls, the latter showed a significantly superior diameter growth over those plants pruned to two-thirds their total height (pp. 15–6).

24.51 : 12.26–8 : 12.11.23. CHANDLER, W. H. **Some responses of trees in a few subtropical, evergreeen species to severe pruning.** *Proc. Amer. Soc. hort. Sci.* 42, 1943 (646–51). [Univ. of California, Los Angeles, Calif.] E.M.B.

Trees of at least some tropical evergreen species make slower growth than deciduous trees in response to severe winter pruning. Trees of certain *Eucalyptus* species will rarely make shoot growth from dormant bud meristem in bark that is directly connected with leafy distal shoots, even in response to very severe cutting of lateral branches from main branches; such pruning will cause strong, much-branched growth in the shoots at the apex of a main branch so that it is in more danger of being broken by the weight of these shoots or by wind. Shoots will grow, however, from stubs beyond the most distal lateral branch left when a main branch is cut back and may grow from the main branch on the side opposite this most distal lateral branch, especially if it is a small drooping one. *From author's summary.*

24.51 : 23.27. ROWLAND, W. S. **Pruning large ornamental trees.** *Proc. 9th West. Shade Tree Conf.* 1942 (366–70).

3. FOREST UTILIZATION. FOREST TECHNOLOGY

31. PROPERTIES AND ANATOMY OF WOOD. WOOD RESEARCH

31. AUSTRALIA. **Council for Scientific and Industrial Research. Division of Forest Products. Annual report, 1942–43.** [Melbourne, 1943?] pp. 17 + [3].

An investigation has shown that in the Izod test with the tougher timbers an unnotched specimen will give results identical to those with a notched specimen of similar size (p. 6).

31. TURNBULL, J. M. **A systematic basis for wood-uses research.** *J. S. Afr. For. Ass.* No. 10, 1943 (51–9). [Forest Products Institute, Pretoria.]

In the past research on wood uses has been concerned largely in comparing the properties of hitherto unused woods with those of woods that are established in specific industries. It is suggested that in many cases the establishment of a wood in an industry has been purely traditional. Therefore, in timber-use investigations, instead of trying to match an established wood, the work should be directed to analysing the manufacturing process and determining the properties required for optimum service in the finished product. A plan for organizing research on wood uses along these lines and of assembling and applying the relevant data is described and illustrated with an example.

31 : 06.1 (43.1–5). 'Deutsche Gesellschaft für Holzforschung gegründet. **[German Association for Wood Research established.]** *Forschungsdienst* 15, 1943 (99–101). [G.] A.P.B.

The association has as its object the advancement of research in the production, utilization and improvement of wood and the application of the work of research in practice. It aims at stimulating investigations, will, where necessary, provide financial support, and will ensure that the results of investigations become known in interested circles. It is intended to create a central board on which all establishments interested in wood will be represented. The ordinary members are regarded as the basis of the association. They consist of members of certain recognized scientific and technical societies which are named. In addition to these ordinary members, the association will include working members and patrons. The latter may be individuals, but they may also be firms or corporations which are particularly interested in the association and which help to support it by voluntary contributions.

The constitution of the association is briefly outlined and the names of the principal officers are given. There will, in the first place, be 5 departments:—(1) wood production, (2) wood-working, (3) wood in construction, (4) wood improvement, and (5) wood chemistry. Further departments may be added if the need arises.

31.0. *General Information on Woods*

31.0 : 12.25 : 12.26–8. **Foreign timbers—3. Notes on Parana Pine—*Araucaria brasiliana*, and Louro Vermelho—probably *Ocotea rubra*.** *Leafl. For. Prod. Res. Lab.* No. 31, 1943. pp.2.

31.0 : 12.26–8. **Foreign timbers—4. Notes on Peroba Rosa—*Aspidosperma polyneuron*, and Mandioqueira—*Qualea* spp.** *Leafl. For. Prod. Res. Lab.* No. 32, 1943. pp. 2.

Brief notes are given on the size, habit and natural habitat of the tree and on the characteristics, properties and qualities of the wood of the four species.

31.0 (71.4) : 12.25–8 : 09.4 : 33.0 : 31.2. **Commercial woods of the Province of Quebec.** Forest Products Bureau, Department of Lands and Forests. 1943. pp. 41.

This bulletin is designed to give some indication of the general uses to which Canadian timbers are put in the manufacturing industries of Quebec. It includes descriptions of the principal generic groups, based largely on 'Native trees of Canada', as published by the Dominion Forest Service, and gives statistics on the area and standing timber of Quebec Province, tables

showing the heating value of the more important species, their weight in air-dry and green condition, board- and cubic-foot scaling tables, and tables of various weights and measures.

31.0 : (66.4 : 66.7–9) : 12.26–8. **Timbers of British West Africa.** Timber Development Association, Ltd., 75, Cannon St., London, E.C.4. [1942?] pp. 50.

Information is given on nomenclature, general characteristics, properties, qualities, uses, and sizes and supplies for each of a number of British West African timbers.

31.0 (66.7–9) : 12.26–8 : 31.2 : 31.43 : 98.2. Scott, M. H. **Some West African substitutes for well-known timbers.** *J.S.Afr.For.Ass.* No. 10, 1943 (29–39 + plates).

With the pre-war sources of most of its timber imports cut off by the war, South Africa is now directly concerned with supplies that are available on the African Continent, particularly in the Belgian Congo. Imports of sawn timber from this territory were 7,000 cu. ft. in 1938 and 600,000 cu. ft. in 1941 and are rapidly increasing.

The author of this article visited the West African territories recently and gives here a brief account of methods of timber transport and conversion used in this region, of the future prospects for its timber trade, and of problems relating to borer damage and its prevention.

Short notes are given on the properties and characteristics of 47 West African timbers of various types that are available as substitutes for the better-known timbers, and at the end of the paper these are listed according to common and botanical names and the average weight in lb. per cu. ft. is given for each.

31.1. *Structure. Anatomy. Identification*

31.1. Ritter, G. J. **The microstructure of cellulose fibers.** U.S. Forest Products Laboratory, Madison, Wis. *Mimeo R*1432, 1942. pp. 5.

The author reviews briefly the literature that appeared during 1938–40, inclusive, on the microstructure of cellulose fibres.

31.1 : 01.4 : 12.25. Australia. **Council for Scientific and Industrial Research. Division of Forest Products. Annual report, 1942–43.** [Melbourne, 1943?] pp. 17 + [3].

Experiments have shown that the method for detecting compression by viewing thin cross sections against a strong source of light [cf. *For. Abstr.* 3 (139)] is 80 per cent. effective with Hoop Pine (*Araucaria cunninghamii*) but considerably less effective with King William Pine (*Athrotaxis selaginoides*) (p. 16).

31.1 : 11.21 : 56.02 : 21.8 : 12.26–8 (54). Chowdhury, K. A. **The formation of growth rings in Indian trees. Part III. A study of the effect of locality.** *Indian For. Rec.* (*n.s.*) *Utilization* 2, 1940 (59–75 + plates). [Forest Research Institute, Dehra Dun.]

Investigations were carried out on the growth activity and dormancy of Teak (*Tectona grandis*) in relation to local climatic conditions in three localities where differences in climate were well marked [Nilambur (West Coast), Kaptai (Chittagong), and Dehra Dun (United Provinces)], and of Mahogany (*Swietenia macrophylla*) in two localities (Kaptai and Nilambur).

Both species usually shed their leaves during the dry season, but leaf-fall does not necessarily begin during the first dry month, and the trees may not remain leafless throughout the dry period. There is a possibility that leaf-fall may be regulated by an internal water balance of the tree. Local temperature appears to play an important rôle in the renewal of cambial activity. Diameter growth usually starts when the temperature is approximately the highest for the year, but cessation of growth seems not to be directly dependent on either local temperature or rainfall. The ring-porous wood of Teak shows some structural variations in the pore zone according to the locality in which it is grown. Mahogany grown in India, on the other hand, does not show any anatomical difference from the same species grown in tropical America.

31.1 : 12.26–8 : 31.21.1 : 11.11.2. Larsen, P. **Die Bedeutung der Winterkälte fur die Kernbildung der Buche. [The importance of winter cold for the formation of heartwood in Beech.]** *Schweiz. Z. Forstw.* 94, 1943 (265–73 + plates). [G.]

A description is given of the abnormal heartwood formed in Beech trees in Denmark as a result of the severe frost that occurred in the winter of 1941–2. Many trees were suddenly affected, including comparatively young trees (40–60 years old). The heartwood has a very large diameter and is unusually dark-coloured.

31.1 : 31.22.2 : 31.3. Schall, W. M. **An investigation of the presence of siliceous rods in the secondary wall of woody tissue.** *Madroño* 7, 1943 (8–14). [Univ. of California, Berkeley, Calif.] A.P.B.

In order to test the validity of the proposal made in 1920 by F. B. H. Brown [*Bull. Torrey bot. Cl.* 47, 1920 (407–24)] that differential wood shrinkage is due to the presence within the secondary wall of wood elements of a skeleton of siliceous rods, the author repeated the procedure carried out by Brown, using the following species:—*Swietenia mahagoni*, *Trochodendron aralioides*, *Quercus alba*, *Cedrela* sp., *Pinus strobus*, and a lapachol ($C_{15}H_{14}O_3$) -forming species of *Tecoma*. The tests made on *Tecoma* sp. are reported in full in order to give data which are comparable with those from the original investigation. As a result of his investigations the author concludes that silica in the form of continuous siliceous skeletons is not present in the secondary wall of woody tissue, and that the silica content of such tissue is such a small percentage of the total weight of the wood that it could not have an effect greater than that of other minerals on the differential swelling or shrinking of wood.

31.1–2. Hale, J. D. **Important characteristics of wood.** *Timber of Canada.* 4 (1), 1943 (82–4, 87).

A brief discussion of the structure of a number of woods in relation to their physical properties, characteristics and uses.

31.2. *Physical Properties*

31.2 : 12.25–8 : 31.23. **Physical properties of woods.** *Mech. World* 114, 1943 (702–3). P.R.

Data presented by Hess [cf. *Mech. Engng.* Sept. 1943] in tabular form, rating the physical properties of 35 woods on a percentage basis and relating each property to specific gravity, is given in diagrammatic form to furnish a guide for quick comparison of the figures of the particular properties.

31.2 : 12.26–8. **Balsa in industry.** *Mech. World* 114, 1943 (657). P.R.

Data are given on the properties and characteristics of Balsa (*Ochroma* spp.) wood, with particular reference to the possibilities for its extensive use in a number of industries.

31.21. Conductivity

31.21.4. MacLean, J. D. **Method of computing the rate of temperature change in wood and plywood panels when the two opposite surfaces are maintained at different temperatures.** U.S. Forest Products Laboratory, Madison, Wis. *Mimeo R*1406, 1943. pp. 22 + tbls. + gphs.

The author describes, and illustrates with examples, methods for determining such temperature changes by means of curves that have been developed at the U.S. Forest Products Laboratory.

31.22. Relation to Water, Air, Gases

31.22.2 : 12.25–8 : 33.36.1. Grachev, I. D., and Kovalenko, A. G. **Impregnation of wood with sugars in order to increase its waterproofness.** *Lesokhim. Prom.* 3 (9), 1940 (29–33). *Chem. Zbl.* I, 1941 (2753). Chem. Abstr. 37 (6430). P.R.

Fir and Pine wood showed a 40 per cent. reduction in swelling, and Birch wood a 50 per cent. reduction after the absorption of 15 per cent. of glucose (from potato molasses) or 55 per cent. sucrose (from 50 per cent. cane sugar solution). The absorption of water was 20 per cent. less for the glucose-treated than for the sucrose-treated wood. The increase in resistance to compression was also greater for the wood impregnated with glucose. This is believed to be due to the lower molecular weight of the glucose and to the fact that it penetrates more readily into the cells of the wood. Impregnation under pressure always resulted in the absorption of less water and more sugar. Increasing the temperature of drying the impregnated specimens from 110 to 141° had no effect on the final properties of the product.

31.22.2 : 33.8. Teesdale, L. V. **Shrinkage of wood in ship construction.** U.S. Forest Products Laboratory, Madison, Wis. *Mimeo R*1424, 1942. pp. 6 + figs. + tbls.

31.27. Mechanical Strength

31.27 : 11.11 : 31.23. Kollmann, F. Über das Gefrieren und den Einfluss tiefer Temperaturen auf die Festigkeit der Hölzer. **[On freezing and the effect of low temperatures on the strength of woods.]** *Mitt. H.-Göring-Akad. dtsch. Forstwiss.* 2 (1). 1942 (317–36). [G.] *Abstr.* in *Forschungsdienst* (*Schrifttum*) 15, 1943 (69). A.P.B.

Numerous tests with seventeen different woods of densities ranging from 0·09 to 1·46 g./cc. at temperatures down to – 60° C. have shown that strength of wood decreases as temperature increases and that the decrease is proportionate to the density of the wood.

31.27 : 31.23 : 12.25 Ylinen, A. **On the influence of the percentage of summerwood and the weight of green wood on the elasticity and strength properties of coniferous timber.** *Acta for. fenn.* 50 (5), 1942 (1–30). [Finn.g.] S.P.S.

Results are given of strength tests carried out on wood samples supplied by the Finnish aircraft factories.

31.27 : 12.25 : 38.2. Whitney, C. S. **Discussion of paper on stress–strain relations in timber beams (Douglas Fir).** With closure by A. G. H. Dietz. *Bull. Amer. Soc. Test. Mat.* 123, 1943 (45–7). P.O.

A critical discussion of a paper on this subject by A. G. H. Dietz [cf. *For. Abstr.* 5 (115)].

31.3. *Chemical Properties*

31.3. **Lignin in wood. TAPPI tentative standard T 13 m-43.** *Paper Tr. J.* 117 (10), 1943 (27–8). P.R.

31.3 : 33.32. **Lignin in wood pulp. TAPPI tentative standard T 222 m-43.** *Paper Tr. J.* 117 (10), 1943 (28–9). P.R.

Tentative standard methods are presented for the determination of lignin in wood and wood pulp.

31.3. Australia. **Council for Scientific and Industrial Research. Division of Forest Products. Annual report, 1942–43.** [Melbourne, 1943?] pp. 17 + [3].

The manganese content of wood can be reduced to less than 2 mg. per 100 g. of wood by the use of an alkaline treatment followed by soaking in cold 10-per-cent. sulphuric acid for 24 hours or by boiling in 1-per-cent. sulphuric acid for 1 hour, and then washing in cold running water (p. 2).

31.3. Coppick, S. **Viscosity and molecular weight. I. The nitrate of wood carbohydrate.** *Paper Tr. J.* 117 (7), 1943 (25–9). P.R.

31.3. Färber, E. **Actual and possible utilization of wood as a chemical raw material.** *Timber of Canada* 4 (1), 1943 (93–4, 97–9).

31.3. Staudinger, H., and Husemann, E. **Macromolecular compounds. CCLXXIV. Abnormal viscosity data of nitrocelluloses from wood.** *Naturwissenschaften* 29, 1941 (534–5). *Chem. Zbl.* II, 1942 (21). Chem. Abstr. 37 (5587). P.R.

31.3 : 12.25. Erdtman, H. Die phenolischen Inhaltsstoffe des Kiefernkernholzes. IV. **[The phenol constituents of Pine heartwood.]** *Svensk PappTidn.* 46, 1943 (226–8). [G.] Plant Breed. Abstr. 14 (326).

Mention is made of some results (to be published elsewhere) of analyses of the heartwood of *Pinus palustris*, *P. nigra*, *P. montana*, and *P. banksiana*.

31.3 : 12.25. Guillemonat, A., and Traynard, P. **So-called native lignin and ethanol-lignin of Spruce.** *Bull. Soc. chim.* 9, 1942 (484–7). Chem. Abstr. 37 (5231). P.R.

31.3 : 12.25. Holmberg, B., and Gralen, N. **Lignin. XIV. The stoichiometry of Spruce lignin.** *Hand. Ing. Ventenskaps Akad.* No. 162, 1942. pp. 26. Chem. Abstr. 37 (6451–3). P.R.

31.3 : 12.25. McNair, J. J., and Jahn, E. C. **Properties of lignin esters.** *Paper Tr. J.* 117 (8), 1943 (29–33). P.R.

Esters of lignin from Lowland White Fir (*Abies grandis*).

31.3 : 12.25–8 (47.3). Sharkov, V. I., and Sobetskii, S. V. **The chemical composition of wood of some species in the U.S.S.R. Wood of the Caucasus.** *Lesokhim. Prom.* No. 8, 1940 (17–21). *Khim. Referat. Zhur.* 4 (3), 1941 (106). Chem. Abstr. 37 (5109). P.R.

In 21 species of trees the contents of ash varied from 0·2 (Pistachio) to 1·28 per cent. (Plane tree). The content of the ether extract did not exceed 3·3 per cent., except in *Cornus mas* L. which yielded 7·16 per cent.

The contents of the alcohol extract varied from 1·23 (*Carpinus betulus* L.) to 15·35 per cent. (*Zelkova erenata* Spach), of lignin from 13·98 (*Ailanthus*) to 30·02 per cent. (*Buxus sempervirens* L.), of pentosans from 10·30 (Fir) to 29·32 per cent. (Beech), of hemicellulose from 18·9 (*Zelkova erenata* Spach) to 37·45 per cent. (*Diospyros lotus* L.), of Kürschner cellulose from 33·38 (*Zelkova erenata* Spach) to 56·05 per cent. (*Ailanthus*), of uronic acids from 1·95 (Fir) to 7·90 per cent. (*Celtis caucasia* Wild.), of methoxyls in the wood from 4·48 (*Cornus mas* L.) to 6·25 per cent. (*Celtis caucasia* Wild.), and of methoxyls in König's lignin from 11·87 (*Carpinus betulus* L.) to 20·18 per cent. (*Diospyros lotus* L.). Two species of trees from Central Asia, 2 from Siberia and 8 from the Far Eastern Region were also analysed.

31.3 : 12.26–8 (729.2). CLARK, E. P. **Quassin. IV. A minor constituent of Jamaica Quassia wood.** *J. Amer. chem. Soc.* 64, 1942 (2883–4). [U.S. Bureau of Entomology and Plant Quarantine.] O.R.S.

A hitherto unrecorded constituent of Jamaica Quassia [*Picraena excelsa*] wood is described. It has the physical properties of an individual compound, but in reality consists of a complex of neoquassin and one or more unknown materials which apparently separate as mixed crystals. *Author's summary.*

31.3 : 12.26–8. HAAS, H. **Composition of the carbohydrate constituents of Red Beechwood.** *J. prakt. Chem.* 161, 1942 (113–36). Chem. Abstr. 37 (5229–31). P.R.

31.3 : 12.26–8 : 34.26 : 12.14.8. LUTZ, L. ***Acacia decurrens* Willd. var. *mollissima*. Willd., the source of Wattle gum.** *J. Pharm. Chim., Paris* 2, 1942 (49–53). *Chem. Zbl.*, II, 1942 (1035). Chem. Abstr. 37 (5196). P.R.

A botanical and pharmacognostic description of wood, bark and gum.

31.3 : 12.26–8. MALMY, M., and BOUVET, P. **Quebrachitol in the leaves of *Acer pseudoplatanus* L. and *Acer platanoides*.** *J. Pharm. Chim., Paris* 2, 1942 (5–10). *Chem. Zbl.* II, 1942 (924). Chem. Abstr. 37 (5196). P.R.

31.4. *Durability. Decomposition*

31.4 : 12.26–8 : 33.52 : 33.36.1. KNUCHEL, H. Ergebnisse eines Versuches mit nicht imprägnierten und imprägnierten Buchenschwellen verschiedener Fällzeit. **[Results of an experiment with non-impregnated and impregnated Beech ties from trees felled at various times.]** *Schweiz. Z. Forstw.* 94, 1943 (83–8 + plates). [G.]

Small-scale tests are described from which it was found that untreated sleepers were badly decayed after seven years irrespective of the felling season of the trees from which the sleepers were made. Sleepers treated with creosote by the Rüping process had remained free from decay.

31.41. Natural Durability

31.41 : 33.54 : 12.26–8. STEVENS, T. D., and PANSHIN, A. J. **Report on fence post experiment on the W. K. Kellogg reforestation tract.** *Quart. Bull. Mich. agric. Exp. Sta.* 26 (1), 1943 (51–2).

From two to six untreated posts each of ten hardwood species common to Michigan were set out for test purposes in 1934. On the basis of the number of posts standing in 1942 it would appear that the most lasting species of those tested, in order of durability, are Sassafras (*Sassafras albidum*), Black Walnut (*Juglans nigra*), Black Cherry (*Prunus serotina*), and White Oak (*Quercus alba*).

31.42. Attack by Plant Organisms

31.42–3 : 12.25 : 33.36.1 : 32.82 (485). BUTOVITSCH, V., and SPAAK, H. Fortsatta försök att skydda i skogen sommerlagrat timmer mot insekter och svampar. **[Further experiments on the protection against insects and fungi of timber stored in the forest during the summer.]** *Norrlands SkogsvFörb. Tidskr.* 1941 (65–119). [Sw.g.] S.P.S.

[Cf. *For. Abstr.* 1 (278).] Comprehensive experiments were carried out in the forest to find the best method of protecting felled timber from damage by insects and fungi. In one case winter-felled Pine timber was treated in April, before the flight of bark beetles, by spraying with sodium or zinc arsenate and various other chemicals. In another experiment, Spruce timber was felled in early summer, treated with chemicals and stored in various ways, including piling and burying in peat. Results after 4–5 months showed that arsenic had been fairly successful against insects but had in some cases stimulated the development of staining fungi, especially on timber free from bark. Sodium arsenate and Rustikol (a wood-tar product) were effective when used in combination. Best results were obtained with the timber buried in peat.

31.42–3 : 32.82 : 33.36.1. BUTOVITSCH, V., and SPAAK, H. Tillvaratagande och behandling av brandskadad skog. **[Taking charge of and treatment of fire damaged forest.]** *Norrlands SkogsvFörb. Tidskr.* 1941 (200–23). [Sw.g.] S.P.S.

Experiments were made to determine the best method for storing fire-damaged timber with minimum damage from fungi and insects. In any case the wood should be utilized as soon as possible, as otherwise damage is soon caused by *Monochamus sutor* and *Ips acuminatus*, often followed by severe staining. Preventive measures recommended include spraying with Lignasan, if the timber is to be stored in the forest, and otherwise water storage.

31.42–3 : 32.82. HEIDIKEN, F. VON. Lagringsskador på vindfällt virke. **[Storage damage to windthrown timber.]** *Norrlands SkogsvFörb. Tidskr.* 1941 (267–85). [Sw.] S.P.S.

Results from the study reported in this paper indicate that if wind-thrown timber cannot be utilized immediately its storage in water or wet soil is the best method of preventing damage from insects and fungi.

31.42–3 : 38.2. **Results of inspection of emergency building projects for decay and insect damage.** U.S. Department of Agriculture Bureau of Plant Industry and Bureau of Entomology and Plant Quarantine. [1942.] pp. 5. P.R.

31.42.11 : 12.21. LOHMEYER. Fäulniserscheinungen an unter Wasser eingebautem Holz. **[Symptoms of decay on submerged constructional timber.]** *Bautechnik* 20, 1942 (270–2). [G.] R.A.M. 22, 1943 (460).

Only recently has the danger of fungal infection on submerged constructional timbers, e.g. bulwarks, piles, bridges, sluices, and the like come to be recognized. Examples of decay in entirely submerged wooden structures that have been studied in Sweden suggest that the organisms involved are resistant to the

ordinarily inhibitive effect of water on fungal development, possibly by the accumulation of oxygen-containing humus. Particulars of a number of similar cases in Germany are presented in tabular form.

31.42.11 : 12.26–8 : 12.21. SCHRENK, H. VON. **A wood-destroying fungus on Gum ties at Jacksonville, Florida.** *Plant Dis. Reptr.* 26 (11), 1942 (260). R.A.M. 22, 1943 (506).

A wood-destroying fungus occurring in large numbers on railway sleepers of Sweet Gum (*Liquidambar styraciflua*), Tupelo (*Nyssa aquatica*), and Black Gum (*N. sylvatica*) wood in Florida, was identified as *Stereum rugosiusculum*.

31.42.12 : 31.43 : 12.25. KIMMEY, J. W., and FURNISS, F. L. **Deterioration of fire-killed Douglas-Fir.** *Tech. Bull. U.S. Dep. Agric.* No. 851, 1943. pp. 61. [U.S. Bureau of Entomology and Plant Quarantine.]

The study was made with the object of obtaining information essential to making comprehensive plans for the salvage of this type of timber. Detailed data were taken on 602 trees in 63 representative areas of the Douglas Fir region of western Oregon and Washington. Fungi and insects, usually acting in close association, were found to be the principal agents causing deterioration. The rate of deterioration and the relative importance of the various species of fungi and insects involved were determined for young-growth stands (fast-grown second-growth stands, generally 100–200 years old), intermediate-growth stands (mature stands, generally 250–350 years old), and old-growth stands (over-mature stands, mostly over 400 years old, containing a large proportion of wood with narrow growth rings). It was found that the sapwood deteriorates so rapidly that it is usually unmerchantable three years after a fire. Deterioration in the heartwood progresses at a slower rate. The most rapid deterioration occurs in the trees of the young-growth type and the slowest in the trees of the old-growth type. Within the growth types, deterioration is generally most rapid in the smallest trees and slowest in the largest trees. The rate of loss is slowest in the butt of a tree and increases with the distance from the ground. Fell. 1 fire-killed trees in open (non-shaded) burns were found to deteriorate at approximately the same rate as standing fire-killed trees.

31.43. Attack by Animal Organisms

31.43 : 31.22.1 : 12.26–8 : 13.2. PARKIN, E. A. **The moisture content of timber in relation to attack by *Lyctus* powder-post beetles.** *Repr.* from *Ann. appl. Biol.* 30 (2), 1943 (136–42). [Forest Products Research Laboratory, Princes Risborough, Bucks.]

The relation between moisture content of Oak sapwood and rate of development of *Lyctus brunneus* has been investigated at 23° C. Oviposition took place normally in samples of various moisture contents between 5·5 and 23·5 per cent. The eggs hatched in wood of 7·7 per cent. moisture content, but not in that of 6·1 per cent. moisture content, although the embryos developed fully. The rate of gain in weight of young larvae increased to a maximum as the moisture content of the wood rose to about 14·2 per cent. and then fell again. The rate of development from egg to adult followed a somewhat similar curve with a maximum at 16 per cent. moisture content. At all moisture contents the first male emerged a few days earlier than the first female. The average weight of the male beetles was less and their moisture content greater than those of the corresponding females. The average weight of the beetles showed a tendency to increase at moisture contents of the wood above 9·7 per cent. The average moisture content of the males was fairly constant up to 15·6 per cent. moisture content of the wood, but that of the females rose slowly as the moisture content of the samples increased. In wood of 15·6 per cent. moisture content at 23° C. the minimum period of development from egg to adult was 167 days; at 14·2 per cent. moisture content and 27·5° C. this was reduced to 142 days. Green timber was shown to be liable to infestation as soon as a superficial skin was formed of a suitable moisture content; the upper limiting moisture content is probably the fibre saturation point. Control of moisture content of timber cannot be achieved sufficiently easily for it to become an important method for the control of *Lyctus* infestation. *From author's summary.*

31.8. *Quality and Defects of Timber*

31.8 : 12.25 : 33.32. JOHANSSON, D. **Beiträge zur Bestimmung der Astmenge im Holz und des Einflusses der Äste auf die Güte des Sulfitzellstoffholzes. [Contributions to the determination of the quantity of knots in wood and of the influence of knots on the quality of sulphite pulpwood.** *Holz* 6, 1943 (45–50). [G.g.] [Zentrallaboratorium der Svenska Cellulosa A/B, Östrand.] P.R.

The quantity of knots in pulpwood was determined for 5 Spruce stems of different quality, partly by measuring the visible knot surfaces, and partly by weighing the undigested knots following a sulphite cook of the wood. It was found *inter alia* that the total visible knot surface per stem, which is best expressed as a percentage of the total stem surface minus the two ends, gives a good indication of the knot content, and that a high knot content corresponds to a low density of the knot-free wood and a comparatively low strength of the sulphite pulp manufactured from it. The wood surrounding the knots yields a particularly weak pulp.

31.8 : 12.26–8 : 12.14.4 : 12.11.23 : 31.1. BURNS, G. P. **Eccentric growth in the main stem of young White Ash trees.** *Bull. Vt. agric. Exp. Sta.* No. 492, 1942. pp. 19 + plates.

Young White Ash (*Fraxinus americana*) bent at various angles, either continuously or discontinuously, formed wood which differed markedly on the upper and lower sides of an annual ring. The cells on the upper side were more numerous, longer, and thicker-walled regardless of the mechanical forces of tension and compression. The excessive cambium activity observed on the upper side seems to be due to a morphogenic response to gravity.

31.8 : 12.26–8 : 33.15 : 31.42–5 : 31.27. HEPTING, H., ROTH, E. R., and LUXFORD, R. F. **The significance of the discolorations in aircraft veneers: Yellowpoplar.** U.S. Forest Products Laboratory, Madison, Wis. *Mimeo* No. 1375, 1942. pp. 8.

The wood in living trees of Yellow Poplar (*Liriodendron tulipifera*) shows a wide variation in colour. Tests were made to compare the toughness of coloured wood with that of bright wood from the same sheet of veneer. Brown was the only colour related to a significant weakness in the wood compared with bright wood. Brown

coloration was due to rot, in which case the reduction in strength was statistically significant, and also to other causes. Toughness was generally related to specific gravity.

Types of coloration found in the wood of Yellow Poplar are described and suggestions are made for culling Yellow Poplar veneer on the basis of colour.

31.8 : 12.26–8 : 33.15 : 31.42–4 : 31.27. SCHEFFER, T. C., and HANSBROUGH, J. R. **The significance of the discolorations in aircraft veneers**: Sweetgum. U.S. Forest Products Laboratory, Madison, Wis. *Mimeo* No. 1376, 1942. pp. 8 + figs.

Tests were made to determine the relationship between colour variations and toughness in the wood of Sweet Gum (*Liquidambar styraciflua*), with particular reference to its use as plywood in aircraft manufacture. Results show that:—(*a*) highly-figured heartwood is not inferior to plain heartwood; (*b*) while mineral streak and blue stain indicate a reduction in toughness, the presence of such discolorations is not objectionable except in large concentrations; (*c*) heavily blue-stained veneer should be examined carefully for the presence of decay; (*d*) veneer containing decay, which in the early stages is indicated by dull yellowish or brown discolorations, or by a bleached appearance, should be removed from sheets to be used in aircraft manufacture.

32. HARVESTING OF WOOD. LOGGING

32 : 12.26–8 (86) : 33.1 : 33.36.3. TEESDALE, L. V. **Production, seasoning and shipping of Balsa. In three parts: log production; milling methods; kiln seasoning.** *Timberman* 44 (11), 1942–43 (38, 40, 42–3); (12), 1942–43 (37–8, 40, 44); 45 (1), 1943–44 (20, 22–3, 26, 28). [U.S. Forest Service.]

An account of Balsa (*Ochroma* spp.) production in Ecuador where about 24 million bd. ft. of this timber were produced in 1942, and the output for 1943 is estimated at 36 million cu. ft. Information is given on felling, log transportation, sawmilling, grading, air and kiln seasoning. This species is not difficult to season as it dries rapidly with little degrade.

32.2. *Felling and Related Operations*

32.25 : 07.7. SVENSSON, R. Vedkilen och killsläggan. [**The timber wedge and sledge hammer.**] *Skogen* 30, 1943 (44–5). [Sw.]

With increased cutting of cordwood in Sweden, the need for improved tools has become apparent; the advantage of standard designs is pointed out. The requirements for a satisfactory wedge are indicated and a new type of wedge is described and illustrated. The aim has been to shape the cutting head in such a way that dangerous flake formation is avoided, and to shape the sides so as to lessen resistance during use without detriment to the splitting effect of the tool. Reference is also made to possible improvements in the sledge hammer.

32.25 : 24.51 : 23.24.2 : 82 : 07.7. HILF, H. H. Den planmässiga förbättringen av skogsarbetet. [**The systematic improvement of forestry work.**] *Svenska SkogsvFören. Tidskr.* 40, 1942 (79–110). [Sw.]

The ultimate object of systematic improvement in the technique of forestry work is to increase the yield. Methods of increasing the speed and efficiency of various operations, including planting, pruning, felling, barking, etc., are discussed, with particular reference to improvements that have been made in tools and equipment. For example, following a series of controlled tests the shape of saw-teeth and size of saws have been standardized.

The importance of collaboration between workers in forest operations is emphasized. The correct postures for the performance of the different operations are illustrated by photographs. [Cf. *For. Abstr.* 5 (81–3).]

R. P. J.

32.25 : 82 : 07.7. HILF, H. H. Skogsarbetsvetenskapen, dess idé och gestaltning. [**The science of forest exploitation, its basis and form.**] *Svenska SkogsvFören. Tidskr.* 39, 1941 (305–31). [Sw.]

An illustrated account of a series of tests that have been conducted in Germany during the last fifteen years to study the time and energy requirements for various kinds of manual work in the forest, and the efficiency of methods and tools used in such work. [Cf. preceding abstract.]

32.25 : 12.25. SEPPÄNEN, V. **The time needed for cutting saw timber.** *Acta for. fenn.* 50 (19), 1942 (1–8). [Finn.g.] S.P.S.

It is estimated that the average time required per cu. ft. to fell, trim, bark and cross-cut Pine and Spruce logs is 3·44 and 3·75 minutes, respectively. Barking takes up about half the total time required (54·5 per cent. for Pine and 47·2 per cent. for Spruce).

32.25.4 : 07.7 : 33.06 : 76.1. TRIMBLE, G. R. **Portable power saws can speed up cordwood production.** *Tech. Note Allegh. For. Exp.* No. 38, 1943. pp. [2].

The use of a portable power saw, having a 28-in. circular blade and driven by an air-cooled petrol motor, for cutting cordwood, gave lower production costs than the usual piece-work method. A three-man crew was used, and on an 8-hour basis, including time for moving and piling the wood on skid roads, the saw could handle about 19·5 cords. In the tests described the average cordwood stick was 3·8 in. in diameter.

32.8. *Grading and Storage of Wood in the Rough*

32.81 : 21.62 : 56.02. ANDERSSON, E. Kvalitetsklassificering av grantimmer efter kvistgrovlecken. [**Grading of Spruce timber by the thickness of knots and branches.**] *Norrlands SkogsvFörb. Tidskr.* 1941. [Sw.] S.P.S.

The branches having the largest diameter are found at 4–6 m. height above the ground; these branches have a decisive influence on the grade of the sawlog taken from the tree. When young trees reach that height (4–6 m.) they develop large branches only if they are widely spaced. The annual rings are then correspondingly wide. By investigating (on the log or by means of borings) the width at stump height of those annual rings that were laid on while branches were formed at 4–6 m. height and correlating these figures with the thickness of the branches at 5 m. height, the author derived a function that enables him to grade the timber before sawing. The classification works very well in practice, as it takes into account the knots that are hidden in the inner part of the stem.

32.9. *Transport*

32.92–4 (47.1) : 09.7 : 65. SEPPÄNEN, O. **The forests in the Tuntsa-Oulanka and Arctic Ocean main waterway regions and long distance transport.** *Acta for. fenn.* 47 (5), 1940 (1–81). [Finn.e.] S.P.S.

The principal method of transporting timber for long distances in Finland is by floating, supplemented by transport in ships, and by railways and lorries. An account is given of the area of forest and lakes, of the growing stock by tree species, and of the transport possibilities for the districts of northern Finland.

33. CONVERSION AND PRESERVATION OF WOOD

33.0. *Utilization Categories of Wood*

33.02. Pulpwood and Chemical Wood

33.02 : 31.2. **Procedure for determining the properties of pulpwood.** U.S. Forest Products Laboratory, Madison, Wis. *Mimeo R*1417, 1942. pp. 24 + figs. + tbl.

This paper describes the standard procedure for determining the properties of pulpwood received at the U.S. Forest Products Laboratory. This includes:—(1) identification of species; (2) description of forest and growth conditions; (3) description of pulpwood; (4) physical properties determined on whole logs; (5) physical properties determined on log sections; (6) chemical properties of wood substance.

33.06. Fuelwood (including Firewood, Charcoal Wood, and Producer Wood)

33.06 : 32.82. Über das Trocknen, Lagern und Verpacken von Gasholz. **[On the drying, storage, and packing of producer wood.]** *Schweiz. Z. Forstw.* 93, 1942 (306–9). [G.]

In Switzerland crates are being used for the packing of producer wood. This simplifies storage problems, makes handling of the wood more convenient, and has the important advantage of allowing the wood to season during the period between packing and use.

33.1. *Mechanical Conversion excluding the Manufacture of Mechanical Pulp*

33.12. Furniture and Cabinet Making

33.12 : 33.34 : 31.21.33. MARRA, G. G. **An analysis of the factors responsible for raised grain on the wood of Oak following sanding and staining.** *Trans. Amer. Soc. mech. Engrs.* 65, 1943 (177–85). P.O.

33.15. Manufacture of Veneers and Laminated Wood. Gluing

33.15. **Compregnated wood now offered.** *Timberman* 45 (1), 1943–44 (65).

General characteristics and physical properties, based on test data, are given for 'Pluswood', a resin impregnated plywood made of Maple and Birch laminations that are bonded under extremely high pressure and intense internal heat. This material is manufactured by Pluswood Inc., Oshkosh, Wisconsin.

33.15. **Notes on flexible bag moulding.** *Aero Res. tech. Notes, Bull.* No. 14, 1944. pp. 8. P.R.

33.15. **Now plywood for tubing.** *Timber of Canada* 4 (4), 1943 (20–2).

Data are given on the process of manufacture and on specifications for small dimensional plywood tubing which is being used extensively in various types of military equipment. The manufacturers, the Plymold Corp., Mass., have developed an automatic machine that will turn out endless lengths of tubing that is bonded and in a final thermoset condition.

33.15. **Notes on the manufacture of flat plywood.** U.S. Forest Products Laboratory, Madison, Wis. *Mimeo R*543 (revised), 1943. pp. 9.

Notes are given on the materials used and on the various operations required in the process of making flat plywood.

33.15. **The coming of plywood: a revolution in the utilization of timber.** *Nature, Lond.* 152, 1943 (651–3).

Reference is made to the properties of wood that favour its use as a structural material, particularly in aircraft construction, and to recent developments in the manufacture and use of plywood. It is pointed out that the increased representation of plywood in the field of timber utilization should eventually bring about a decrease in total annual timber requirements.

33.15. BROWN, D. W. **Plastic glues and cements.** *Plastics* 7, 1943 (480–5). P.R.

Notes are given on the uses, methods of application, and practical advantages of plastic glues and cements, particularly phenolic cements, dry gluefilm phenolic adhesives, and urea-formaldehyde glues.

33.15. EILERTSEN, L. W. **Assembly time in the gluing operation.** *Construction Glues* 1 (6), 1942 (3). Chem. Abstr. 37 (6056). P.R.

In gluing operations the assembly time is influenced by moisture content of the wood, water content of the glue, temperature, porous structure of the wood, amount of bonding pressure, and amount of glue spread. These factors are discussed, and the use of urea-HCHO, phenolic and melamine types of resins in low-temperature, quick-setting glues is described.

33.15. GOLDSCHMIDT, T., A.-G. **Adhesive for plywood.** *German Patent* No. 725,650, Aug. 13, 1942 (Cl. 22*i*. 2). Chem. Abstr. 37 (6060). P.R.

A porous carrier saturated with an aqueous alkaline solution of phenol and especially cresol-CH_2O condensation product is used as adhesive for plywood. This adhesive is used under heat and pressure.

33.15. HARKOM, J. F. **Moulding plywood products to double curvature.** *Timber of Canada* 4 (1), 1943 (90–1).

33.15. HYLER, J. E. **Heat in plywood bonding.** *Veneers and Plywood* 37 (8), 1943 (20, 22). P.R.

33.15. HYLER, J. E. **Sanding, finishing and assembling plywood.** *Veneers and Plywood* 37 (9), 1943 (20, 22). P.R.

33.15. **Jablo airscrew blades: their manufacture from the log to the finished component by F. Hills and Sons, Ltd.** *Repr.* from *Aircraft Production*, April 1942. pp. 6. P.R.

An illustrated account of the manufacture of Jablo blades, which are fabricated from multi-plyboards consisting of boards about 1 in. thick, built up from 50 or more 0·6 mm. Birch plies bonded together under considerable pressure and at a high temperature by a synthetic glue. This account includes the preliminary stages of manufacture from the log to the built-up block as well as the later stages of machining, balancing and surface-finishing the blade.

33.15. JICWOOD, LTD., and FARINA, R. L. J. **Resin-impregnated compressed wood.** *British Patent* No. 547,128, August 14, 1942. Chem. Abstr. 37 (5520). P.R.

Water-resistant wood is obtained by impregnating the wood with an aqueous solution of phenol and

$(CH_2)_6N_4$. The water content is then evaporated and the wood subjected to heat and pressure to compress it to the required degree, and at the same time convert the residue of the solution into an insoluble resite.

33.15. KILLINGER, J. E. **Lamination of weather-proof solid fiberboard with starch and resin adhesives.** *Paper Tr. J.* 117 (19), 1943 (25–30). P.R.

33.15. KRESS, H. **Refining wood.** *German Patent* No. 724,402, July 16, 1942 (Cl. 38*h*. 1.01). Chem. Abstr. 37 (5844). P.R.

Wood is leached with an aqueous solution containing pancreatic enzymes along with Na_3PO_4, Na_2CO_3 and (or) borax. After this the wood is washed and dried.

33.15. LOUGHBOROUGH, W. K. (to the Secretary of Agriculture of the U.S.A. and his successors in office). **Resinified wood products suitable for molded articles or plywood, etc.** *U.S. Patent* No. 2,313,953, March 16, 1943. Chem. Abstr. 37 (5165). P.R.

A highly plastic product which finally becomes resinified is prepared by soaking comminuted or sheet wood in an aqueous CH_2O-urea solution which contains an excess of urea, on an atomic weight basis, and also contains buffers such as borax or Na acid phosphate which maintain its pH at about 8, removing the wood from the solution, heating it to about 212° F., altering the shape of the heated wood, as by bending or pressing, drying it, and heating it to about 300° F. until resinification is complete.

33.15. PATERSON, A., LUBICZ, N., and MANIFOLD DEVELOPMENTS, LTD. **Manufacture of wood composition [board].** *British Patent* No. 553,609, Nov. 26, 1941. B.C.P.A. 1943, B.I. (373). P.R.

Wood waste is coated, e.g. by spraying while in movement, with a limited quantity of a synthetic phenol- or amino-plastic, and the mixture is moulded by hot-pressing.

33.15. PERRY, T. D. **Moulding curved plastic-plywood.** *Modern Plastics* 20 (12), 1943 (73–7, 130, 132, 134). P.O.

An illustrated account of the methods and equipment used and of the materials required in the moulding of curved plastic plywood.

33.15. PERRY, T. D. **The modern method of making curved plywood.** *Veneers and Plywood* 37 (8), 1943 (10–2). [Resinous Products & Chemical Co., Philadelphia, Pa.] P.R.

A brief, illustrated account of three principal methods of making curved plywood with flexible pressure bags. [See also *Mech. Engng., N.Y.* 65, 1943 (417–24).]

33.15. **Veneer joining.** *Aero Res. tech. Notes, Bull.* No. 11, 1943. pp. 6. P.R.

Notes are given on equipment, methods and glues used in edge-to-edge joining of veneers.

33.15 : 07.7. **Notes on hot press technique.** *Aero Res. tech. Notes, Bull.* No. 13, 1944. pp. 6. P.R.

Brief notes on veneer requirements, the use of aluminium hot-press cauls, supplementary equipment, methods of charging the hot press, press operation, steam requirements, setting time, and stacking after pressing.

33.15 : 12.26–8 : 31.27. **Strength data of moulded Birch plywood angles.** Pacific Veneer Co., Ltd., New Westminster, B.C. *Project* No. 118, 1943. pp. 7. P.R.

33.15 : 12.26–8 (94). AUSTRALIA. **Council for Scientific and Industrial Research. Division of Forest Products. Annual report, 1942–43.** [Melbourne, 1943?] pp. 17 + [3].

Tests have shown that a number of Australian timbers including Brush Mahogany (*Geissois benthami*), Silver Ash (*Flindersia* sp.), and Myrtle Beech (*Nothofagus cunninghamii*) have suitable properties for use in aircraft construction, although species of Eucalypts have not given satisfactory results owing to difficulties in obtaining adhesion with waterproof resin glues and to inferior mechanical properties (p. 7).

33.15 : 31.2 : 38.1. DUDLEY, L. P. **Plastics in structural engineering.** *Plastics* 7, 1943 (377–83). P.O.

A comparison is made between the structural properties of a plastic of the laminated veneer type (laminated $\frac{1}{16}$-in. Birch veneers) and those of AZM magnesium alloy, duralumin and a typical grade of mild steel.

33.15 : 31.2. JERVIS, A. E. L. **Synthetic resin laminated wood insulation.** *Brit. Plast.* 15, 1943 (223–8). P.O.

A brief account of the materials and methods used in the manufacture of laminated wood, together with a number of graphs and tables giving the results of various tests made on laminated wood by Moulded Components (Jablo), Ltd.

33.15 : 31.27. DIETZ, A. G. H., and GRINSFELDER, H. **Behavior of plywood under repeated stresses.** *Trans. Amer. Soc. mech. Engrs.* 65, 1943 (187–91). P.O.

From the tests that have so far been made it is concluded that, for Birch plywood and laminated wood bonded with thermosetting phenol-formaldehyde film, and for plywood bonded with an aqueous dispersion of cold-setting urea-formaldehyde resin, (*a*) fatigue failures are primarily wood failures, (*b*) delamination of the veneers occurs very seldom before the outer plies have given way, (*c*) the material may be expected to withstand at least 2,000,000 stress reversals without failing, when stressed to 25 per cent. or less of the static modulus of rupture.

33.15 : 31.27. EICKNER, H. W. **Rate of setting of cold-setting urea-resin glue joints.** U.S. Forest Products Laboratory, Madison, Wis. *Mimeo R*1422, 1942. pp. 8 + tbls. + figs.

Tests were made on the rate of setting of cold-setting, urea-resin glues used with Sugar Maple and Sitka Spruce lumber and with Yellow Birch veneers. Data are given on strength of joints in relation to pressure period, pressing temperature, and aging. Results from the tests indicate that the pressure period required for a lumber joint can be greatly reduced by increasing the pressing temperature. Strength of joints was found to develop mainly during the early part of the pressure period and it is noted that where speed is essential, satisfactory joints can usually be obtained with pressure periods of 1 hour at 90° F. or 2 hours at 75° F. if the joints are allowed to condition before being stressed. These are minimum periods and must be checked with the material available.

33.15 : 31.27 : 31.23. FINLAYSON, M. **High-density plywood.** *Trans. Amer. Soc. mech. Engrs.* 65, 1943 (193–9). [Armstrong Cork Co., Lancaster, Pa.] P.O.

The physical properties of high-density plywood produced from Tego-bonded Birch veneer, the grain direction of all plies parallel, are presented and compared with the corresponding properties of various metals. It is shown that the strength properties are directly related to the specific gravity. Stress–strain curves in

tension indicate that this material not only has no normal yield point but actually shows a decrease in elongation per unit load at high loads. The moduli of elasticity in tension and compression are shown to be greatly different. The behaviour in torsion is discussed, and the effect on the tensile strength of cross-laying the veneers is presented. The effect of immersion in water and the effect of various humidity conditions are given. *Author's summary.*

33.15 : 33.8. NEBESAR, R. J. **Molded plastic-bonded veneers and wood in aircraft construction.** *Mech. Engng.* 65, 1943 (197–201). [Universal Moulded Products Corporation, Bristol, Va.] O.R.S.

33.15 : 38.2. STEPHAN, J. T. **Laminated beam fabrication with warm-temperature setting adhesives.** *Timberman* 44 (12), 1942–43 (66).

Boiling water or steam is used as the source of heat in bonding beams, 4 × 4 in. in cross-section and larger, with warm-temperature setting adhesives, for which hot platens and other similar methods are usually impractical. Approximate boiling times for beams of different cross-sections are given.

33.15 : 98.2 (941). AUSTRALIA. **Council for Scientific and Industrial Research. Division of Forest Products. Annual report, 1942–43.** [Melbourne, 1943?] pp. 17 + [3].

Satisfactory results obtained in peeling tests and plywood manufacture with Karri (*Eucalyptus diversicolor*) are to be used as the basis for establishing the plywood industry in Western Australia (p. 11).

33.19. Other Forms of Mechanical Conversion

33.19 : 33.8. PECK, E. C. **Wood bending in shipbuilding.** U.S. Forest Products Laboratory, Madison, Wis. *Mimeo R*1430, 1943. pp. 4 + figs.

The production of bent wood parts is discussed briefly with reference to (1) selection of stock; (2) seasoning of stock; (3) preparation of bending blanks; (4) softening of the wood; (5) the bending operation; and (6) fixing of the bent shape.

33.3. *Chemical Treatment*

33.3. BREIREM, K. **Cellulose as fodder.** *Tidsskr. Skogbr.* 1940 (196–203). [Nor.] S.P.S.

Common straw fodder is digested to the extent of 40–50 per cent. by volume; this is increased to 90 per cent. if the straw is treated with solutions similar to those used in the sulphite and sulphate pulp industries. Wood cellulose has the same fodder value as straw cellulose for cattle and horses but not for pigs or poultry.

33.3. WERNER, A. Die Aufschliessung von Stroh und Holz zu Futterzwecken. [**The decomposition of straw and wood for fodder purposes.**] *Mitt. Landw., Berlin* 58, 1943 (99–100). [G.] Herb. Abstr. 13 (1104).

The nutritive value for ruminants and horses of decomposed straw and of fodder cellulose prepared from wood is discussed.

The fodder cellulose obtained from wood by means of the sulphite, sulphate, or caustic soda processes is a factory product of high nutritive value corresponding approximately to that of oats. It is a carbohydrate of high value, but is practically a pure substance; that is to say, it contains no protein, no mineral substances, no vitamins, and naturally has to be supplemented by protein rations such as hay and, in the case of dairy cows, by succulents. The process employed in Germany is the cheaper caustic soda method.

33.32. Pulp and Paper Manufacture. Plastics

33.32. BECK, J., and JAHRSTORFER, M. (to I.G. Farbenind. A.-G.). **Products of wood refining.** *German Patent* No. 712,666, Sept. 25, 1941 (Cl. 120. 6). Chem. Abstr. 37 (4570–1). P.R.

Wood is digested with an alkali hydroxide and the product is etherified with a monohaloacetic acid or its salt.

33.32. DREYFUS, H. **Wood cellulose: preparation.** *British Patent* No. 555,985, Sept. 9, 1943. Brit. Cotton Ind. Res. Ass. Summ. 23 (547). P.R.

Cellulose for rayon and cellulose derivatives is obtained by subjecting wood, straws, or grasses to the action of an oxidizing agent or oxygen itself, in the presence of an organic acid solution of a metal salt that acts as an oxidation catalyst. The oxidizing agent is preferably hydrogen peroxide, but metal peroxide, free oxygen or air may be used. The organic acid is preferably acetic, butyric or propionic acid. A salt of Co, Ni, Fe, Cr, Al or Mn, especially manganese acetate. may be used as the catalyst. After the oxidation treatment the cellulosic material is treated for a short time with a hot dilute solution of alkali to dissolve the oxidation products and is then treated with a mercerizing solution of 9 to 15 per cent. sodium hydroxide in order to remove hemicellulose.

33.32. GRAFF, J. H. **The number of fibers per gram of pulp and its relation to fiber dimensions.** *Paper Tr. J.* 117 (17), 1943 (25–31). [Institute of Paper Chemistry, Appleton, Wis.] P.R.

33.32. HILL, A. C. **Development of paper products for military uses.** *Timber of Canada* 4 (1), 1943 (66–9, 164).

33.32. KÖNIG, J. **Plastic mass.** *German Patent* No. 711,886, Sept. 11, 1941 (Cl. 39*b*. 15). Chem. Abstr. 37 (4498). P.R.

Wood is digested with H_2SO_4 (specific gravity 1·53) at room temperature. After the cellulose dissolves H_2O is added in an amount equalling that of the H_2SO_4. The lignin-hydro-cellulose mixture is separated, washed and dried under pressure.

33.32. KRESS, O., and RATLIFF, F. T. **A comparison of southern and northern kraft pulps.** *Paper Tr. J.* 117 (17), 1943 (31–5). [Institute of Paper Chemistry, Appleton, Wis.] P.R.

An attempt was made to account for the differences between pulps produced from woods grown in the southern and in the northern United States. The usual physical tests and chemical analyses gave no tangible results. Indications were obtained that the fibre-to-fibre bonding strength and the specific surface area may partly account for such differences, although this has yet to be confirmed. *From authors' summary.*

33.32. KRESSMAN, F. W. (to Continental Turpentine and Rosin Corp. Inc.). **Separation of highly absorbent wood fibers suitable for roofing felt manufacture.** *U.S. Patent* No. 2,315,372, March 30, 1943. Chem. Abstr. 37 (5568–9). P.R.

A process is employed for separating highly absorbent wood fibres from other woody and less fibrous particles, into bundles of substantially uniform density

which involves treating wood fibres with moisture until the fibres contain over 15 per cent. of moisture, drying to reduce the moisture content to about 15 per cent., and passing the partially dried product through a rapidly moving current of air by which the bundles of fibres of relatively low density are separated from those of relatively high density.

33.32. Mason, W. H., Boehm, R. M., and Simpson, G. G. (to Masonite Corp.). **'Double-activation' process of making hard fiber board.** *U.S. Patent* No. 2,317,394, April 27, 1943. Chem. Abstr. 37 (5844). P.R.

A process is employed which involves subjecting wood or woody lignocellulosic material, composed of lignocellulose fibers containing the natural fibre encrustation, in small pieces, to the action of steam at a temperature above 200° and corresponding pressure; maintaining the treatment with steam at such temperature and pressure for a time that is too long with relation to the steam temperature for production of raw fibre by means of explosion with steam, but not long enough to produce a general breakdown of fibre structure or conversion to a state of predominant plasticity, to produce a material initial activation of the self-bonding properties of the lignocellulose fibres, reducing the steam-treated fibrous material to greater fineness, removing at least part of the water-soluble constituents, forming a sheet of the fine fibre, drying the sheet, subjecting the sheet to sustained consolidating pressure of at least 500 lb. per sq. in. in a platen press between pressing surfaces heated above 200° and maintaining the application of such pressure and temperature to the sheet for a time which with pressure and temperature used is sufficient to activate the self-bonding properties of the lignocellulose fibres a second time and produce the superior hard fibre board, the time of sustained-pressure application being approximately 3 minutes when platen pressure of 700 lb. per sq. in. is used with pressing surfaces at a temperature of 210°.

33.32 : 12.25. Billington, P. S., and Fiedler, E. L. **The chemical properties of White Spruce pulp prepared by the use of phenol.** U.S. Forest Products Laboratory, Madison, Wis. *Mimeo R*1418, 1942. pp. 9 + tbl. + figs.

33.32 : 12.25. Martin, J. S., and Bray, M. W. **Effect of chemical-wood ratio in pulping Douglas Fir by the sulphate process.** *Paper Tr. J.* 117 (12), 1943 (29–33). P.R.

Systematic variation of the chemical-wood ratio in the sulphate process can be used as a measure of the relative ease of fiberization among species. Chemical consumption and yields of screened pulp and screenings in the pulping of Douglas Fir (*Pseudotsuga taxifolia*), when compared with previously obtained data on Longleaf Pine (*Pinus palustris*), indicated that Douglas Fir fiberizes slightly more readily than does Longleaf Pine. The values obtained at given chemical-wood ratios for total pulp yields, chemical consumptions, bleach requirements, and pulp strength were generally of the same magnitude for both Douglas Fir and Longleaf Pine. The significant differences in pulp properties that seemed capable of distinguishing the Douglas Fir from Longleaf Pine were a 1·0 gm. per pound per ream higher tearing resistance, a 3-per-cent. higher alpha-cellulose content for the well-cooked pulps, and a darker colour for the unbleached raw pulps. Changes in the chemical-wood ratio had less effect on the length of time needed to beat the Douglas Fir pulps to a certain freeness than on the time necessary for the Longleaf Pine pulps to reach the same freeness. *Authors' summary.*

33.32 : 12.25. Kress, O., and Mosher, R. H. **The pulping of extracted Yellow Pine wood chips.** *Sth. Pulp Paper J.* 6 (5), 1943 (19–21, 23–4, 26).

Solvent-extracted root wood of Southern Pine was cooked by the kraft process under a variety of conditions within the commercial range. In no case was the yield of pulp over 37 per cent. (on the basis of the extractive-free material), and the maximum strength of the pulp was about 50 per cent. of that of normal Jack Pine kraft pulp.

Wood containing extractives gave lower yields and pulps with lower strength values than those obtained from the extractive-free material.

The fibres of the pulps obtained from root wood hydrate immediately on contact with water but do not develop normal strength on beating. *From authors' summary.*

33.32 (469) : 12.25–8 : 98.1. Seabra, L. S. V. de. **O problema nacional da celulose. [The national pulp problem.]** Direcção Geral dos Serviços Florestais e Aqüicolas. 1943. pp. 34 + plates. [Port.]

Since 1939 the import of paper pulp into Portugal has been very seriously curtailed, while the price of the imported pulp has been more than doubled. In order to increase and develop pulp production within the country, the Forest Service set up a research laboratory in 1938. Pulping tests have been carried out with the wood of different tree species, including *Eucalyptus globulus* and *Pinus pinaster*, which had been used for some time in Portuguese pulp manufacture. Short notes are given on these tests and on tests carried out with miscellaneous raw materials (rice straw, etc.).

33.32 : 12.26–8. Hossfeld, R. L., Gortner, R. A., and Kaufert, F. H. **The cooking process. Action of aqueous solutions of pure sodium hydrosulfide on Aspen wood.** *Industr. Engng. Chem.* (*Industr. Ed.*) 35, 1943 (717–20). [Minnesota Agricultural Exp. Sta., St. Paul, Minn.] L.S.

Alcohol-benzene extracted Aspen sawdust was cooked under varying conditions of time, temperature, and concentration with aqueous solutions of pure sodium hydrosulphide. The resulting cooks were individually separated into seven fractions—steam-volatile oil, residual wood, volatile acid, water-insoluble pitch, ether-extractable non-volatile oil, lignin, and a methanol-soluble syrup. In all cases the residual wood was completely unpulped except when impure hydrosulphide was used.

33.32 : 34.6. Charisius, K. **The mechanical properties of wood-flour cements in relation to their composition.** *Wiss. Abh. dtsch. Materialprüfungsanst.* 2 (4), 1942 (6–19). Chem. Abstr. 37 (5211). P.R.

33.32 : 38.1 : 34.6. Bennie, J. **Improvements in or relating to the manufacture of wall-boards or slabs.** *British Patent* No. 551,658. [1943?] Build. Sci. Abstr. 16 (*n.s.*), 1943 (588). P.R.

A process for the manufacture of a wall-board, block, tile slab or like building element which comprises preparing a thick paste of mineral filler, wood wool or sawdust, alkali silicofluoride, alkali silicate and water,

the amount of wood wool or sawdust comprising 15 to 40 per cent. by weight of the weight of the paste, pressing the paste to form the wall-board, block, tile, slab or like building element desired and subjecting the article to drying.

33.32 : 38.1 : 34.6. BENNIE, J. **Improvements in or relating to the manufacture of wall-boards or slabs.** *British Patent* No. 551,701. [1943?] Build. Sci. Abstr. 16 (*n.s.*), 1943 (589). P.R.

A process for the manufacture of a wall-board, block, tile slab or like building element which process comprises mixing together sawdust, a hydraulic cement and, if desired, a filling agent, with an aqueous solution of a binder consisting of alkali silicate, and with sodium silicofluoride, moulding the plastic mixture into the form of the building element desired and allowing or causing it to be set.

33.36. Preservation of Wood. Seasoning and Drying

33.36 (43.1–5) : 09.4 : 31.41 : 12.25–8. WÜSTENDÖRFER. Tränken und Trocknen von Holz bei der Deutschen Reichsbahn. [**Impregnation and seasoning of timber by the Deutsche Reichsbahn.**] *Z. Weltforstwirt.* 9, 1942 (499–500). [G.]

The data presented are based on a thesis by O. Gröner (Die Holzwirtschaft bei der Deutschen Reichsbahn, Stuttgart, 1939). The Reichsbahn uses large quantities of timber; 135 million sleepers are in service in Greater Germany, while building timber in use in the Altreich amounted in 1937 to 25 million cu. m. Both mineral and organic preservatives are used, the latter being chiefly creosote. For most types of timber, including sleepers, impregnation is by the Rueping process. The following figures are given for the average life of untreated and treated sleepers in the Altreich:— Scots Pine, 5 and 27 years; Oak, 13·5 and 27·5 years; Beech, 2·5 and 33 years. The total number of sleepers in service in the Altreich is 118 million, of which 74 per cent. are Scots Pine, 4 per cent. Oak, and 22 per cent. Beech sleepers. Most of the timber used by the Reichsbahn is kiln dried.

33.36.1. *Preservation against Attack by Plants and Animals*

33.36.1. PROULX, J. **Treatment of wood blocks for suction-box covers and the like.** *U.S. Patent* No. 2,312,978, March 2, 1943. Chem. Abstr. 37 (5216–7). P.R.

A treatment is employed which involves removing the air and moisture from the cell interior of the wood by subjecting the blocks to reduced pressure, immersing the blocks in a molten mixture of a normally very hard paraffin with about 0·5–10 per cent. of lanolin, heating to 100° and at a reduced pressure of 20–26 mm. Hg for about 2 hours, raising the pressure to normal, removing the blocks from the mixture and cooling.

33.36.1 : 12.25. DEITERS, A. M. **Wood preserving in the South.** *Sth. Pwr. Ind.* 61 (7), 1943 (62–8). Chem. Abstr. 37 (4874–5). P.R.

The most widely used and dependable of all wood preservatives is coal-tar creosote, with or without admixture with water-gas tar, water-gas-tar creosote, wood-tar creosote, coal tar and petroleum oils. $ZnCl_2$ is the water-soluble salt most commonly used, and in modern practice this is combined with $Na_2Cr_2O_7$ to form chromated zinc chloride. Like all water-soluble salts, $ZnCl_2$ leaches out more readily than creosote under damp conditions. New preservatives consisting of chemicals in non-aqueous solvents provide a clean treatment without swelling of the wood, but longer service tests are required to establish their value. Wood to be creosoted should be dry; this is usually accomplished by air-drying, but Southern Yellow Pine can be quickly conditioned by the steam and vacuum process. Hardwoods are conditioned by the Boulton process in which they are immersed in creosote at approximately 220° F. in a chamber with a vacuum of not less than 20 in. The Rueping, Lowry and Bethell creosoting processes are described. Bleeding of creosote has been partially reduced by addition of lecithin to the creosote (patented). Use of creosoted wood is increasing rapidly; further application in houses is desirable. Statistics are given.

33.36.1 (73) : 33.31. **Record-breaking quantity of piles, timber and lumber, and wood blocks treated in 1942.** *Wood Pres. News* 21, 1943 (98–101). P.R.

Statistics are given on the amount of timber of different classes that was treated with preservatives in the United States during 1942 and on the quantity of preservatives used.

33.36.1 : 33.31. BOSTRUM, E. (to Osmose Wood Preserving Co. of Canada, Ltd.) **Preservation of wood.** *Canadian Patent* No. 411,809, April 13, 1943. Chem. Abstr. 37 (4548). P.R.

A viscous, tacky non-aqueous compound comprising a water-insoluble organic wood preservative consisting of normally solid pitch carrying in suspension a solid water-soluble preservative is applied to the debarked wood surface, and the water-soluble preservative is allowed to diffuse into the moist wood by osmosis. The water-insoluble preservative forms a water-impervious zone at the wood surface to prevent the leaching of the water-soluble preservative.

33.36.1 : 33.31. EASTWOOD, T. M. **Chemical preservative helps growers extend life of benches, flats.** *Flor. Rev.* 91 (2354), 1943 (15–6). Biol. Abstr. 17 (22573).

Preliminary trials were conducted on Redwood flats to prevent decay using a proprietary material, Permasan 116, composed of 5 per cent. by weight of pentachlorophenol in volatile petroleum hydrocarbons. Flats were dipped into this solution for 3–5 minutes. At least 80 per cent. by weight of the volatile wood preservative must be removed to prevent toxicity. The injurious part seemed to be the solvent for the pentachlorophenol. Tomato plants growing in the flats where the majority of the volatile materials had been removed had normal growth and uninjured roots.

33.36.1 : 33.31 : 31.43 : 13.2. MILLS, L. E. (to the Dow Chemical Co.). **Protecting wood against attack by termites.** *U.S. Patent* No. 2,314,362, March 23, 1943. Chem. Abstr. 37 (5216). P.R.

Wood is impregnated with a solution of hexachlorocyclohexa-1, 4-diene-3-one as an active toxicant, dissolved in an organic solvent such as a petroleum oil and applied under pressure.

33.36.1 : 31.43 : 13.2. PEMBERTON, C. E. **Entomology.** *Rep. Comm. Exp. Sta. Hawaii Sug. Pl. Ass. 1941–42,* 1943 (18–22). R.A.E. 31A, 1943 (524–5).

Timber impregnated with copper naphthenate and buried in the soil and untreated timber buried in soil

treated with a proprietary oily liquid known as Standard Oil Termite Compound remained undamaged by *Coptotermes formosanus*, Shir., after a period of 13 months, when untreated timber and timber in untreated soil was completely destroyed. Buried timber was also protected from termite attack by treating the soil with a strong solution of sodium arsenite.

33.36.1 : 33.51. HITCHENS, R. M. (to Monsanto Chemical Co.). **Wood preservative.** *Canadian Patent* No. 414,732, August 24, 1943. Chem. Abstr. 37 (6432). P.R.

An aqueous solution containing a water-soluble salt of a polychlorophenol is specified; e.g. Na2,3,4,6-tetrachlorophenoxide and a mixture of $NaHCO_3$ 2 parts and Na_2CO_3 1 part, the initial pH value being about 6·8–9·2.

33.36.1 : 33.52 : 31.43 : 13.2. DUNCAN, H. R. *et al.* **Report of Committee 17—wood preservation.** *Proc. Amer. Rly. Engng. Ass.* 1943 (623–49). Chem. Abstr. 37 (6430–1). P.R.

Inspections of test tracks on the railroads involving ties treated with various preservatives by various processes are reported. Results of exposure tests for resistance to marine borer attack at various locations in Canada and the United States are given. Tests in tropical waters could not be inspected on account of war conditions. A brief report on destruction by termites and possible ways of prevention is presented, including an experiment to show the effectiveness of metal shields.

33.36.1 : 33.54 : 12.25–8. WAGNER, H. Sachgemässer Holzschutz. **[A satisfactory method of wood preservation.]** *Mitt. Landw., Berlin* 58, 1943 (533). [G.] A.P.B.

According to the author impregnation by steeping is the only satisfactory method of treating posts with water-soluble salts. Complete immersion is not necessary. It is often sufficient to impregnate only those parts which are in direct contact with the ground and for a distance of about 20–30 cm. above ground level. Instructions are given for wood impregnation by this method. With a 4-per-cent. salt solution the times necessary for impregnation are as follows:—

Diameter of post	*Time required in days*			
	Oak	*Larch*	*Pine*	*Spruce*
6 cm.	2–3	3–5	4–6	6–8
12 ,,	3–5	5–7	6–8	8–10
15 ,,	5–6	7–8	8–10	10–12

After impregnation the posts should be piled for about 14 days, if possible protected from rain, to allow the salt to become fixed.

33.36.1–2 : 33.31. ARNOLD, W. P. **Chemically treated wood in war and industry.** *Chem. Engng. News* 21, 1943 (1168–71). [Koppers Company, Orrville, Ohio.] L.S.

An account is given of methods and materials used in the treatment of timber for preservation against decay, for fireproofing, and other purposes. Uses for pressure-treated wood are listed.

33.36.2. *Fireproofing*

33.36.2 : 38.2. RITCHIE, J. E. **Fire resistive wood construction.** *Aust. Timb. J.* 9, 1943 (353, 355, 359).

33.36.2 : 33.31. **Reducing fire hazard.** *Amer. City* 58 (6), 1943 (76–7). L.S.

Incendiary-bomb tests have shown that a phosphate-alginate paint developed at the U.S. Forest Products Laboratory is an effective fire retardant if used properly and applied in sufficient quantity. A particularly effective fire-retardant chemical is Firepel 'S' recently developed by the Albi Firepel Corporation, New York.

33.36.2 : 33.31. GOLLOP, G. E. **The flameproofing of wood.** *Timber of Canada* 4 (1), 1943 (73–5, 156, 158).

It has been shown that flameproofing will reduce to a marked degree the fire hazard of wood. Fire-retarding chemicals may be applied by (1) impregnating the wood with a water solution of the chemicals, either by soaking or by pressure impregnation, or (2) applying a surface coat of fire retardants either in solution or suspension.

A chemical known as 'Faspos' that has both fire-retardant and fungicidal properties is made by Imperial Chemical Industries, Ltd.

Tests have shown that chromated zinc chloride applied to Douglas Fir and Southern Yellow Pine lumber by pressure impregnation was effective in reducing fire hazard, the reduction being commensurate to the quantity of chemicals retained in the wood.

33.36.3. *Seasoning. Drying*

33.36.3 : 07.7. TIEMANN, H. D. **Compartment or progressive kiln?** *Sth. Lumberm.* 167 (2095), 1943 (49–50); (2097), 1943 (53–5); (2099), 1943 (47–8).

Factors affecting the operation and efficiency of the two types of kilns are discussed and the relative merits of the two systems are noted.

33.36.3 : 31.22.2 : 12.25–8 (94). WRIGHT, G. W., and GREENHILL, W. L. **The seasoning and shrinkage of Australian timbers for shipbuilding.** *Aust. Timb. J.* 9, 1943 (298, 300, 313, 315, 317). [C.S.I.R. Division of Forest Products.]

Notes are given on the seasoning requirements of timbers to be used for various purposes in shipbuilding, the principles to be followed in air seasoning, the measurement of the moisture content of timber, and on the shrinkage of wood while drying. Figures are given for the average shrinkage of a number of Australian timbers during drying from the green condition to 20, 16 and 12 per cent. moisture content.

33.36.3 : 33.15 : 01.4. TAYLOR, J. P. **Heating wood with radio-frequency power.** *Trans. Amer. Soc. mech. Engrs.* 65, 1943 (201–12). P.O.

The theory of radio-frequency heating is considered briefly, the factors which determine its applicability and usefulness are discussed, and some data for the calculation of power required, time cycle, and operating cost are presented. Means of handling some specific problems are reviewed and several typical installations briefly discussed.

33.36.3 : 33.8. TEESDALE, L. V. **Seasoning wood for ship construction.** U.S. Forest Products Laboratory, Madison, Wis. *Mimeo R*1423, 1942. pp. 9 + figs.

The general practices to be followed in air seasoning and kiln drying are outlined and notes are included on water storage, use of moisture-repellant coatings, and the chemical treatment of wood for the purpose of moisture retention.

33.37. Distillation. Manufacture of Tar

33.37–8 : 07.7 : 34.6. Svensk transportabel träkolsugn. [**A portable charcoal kiln of Swedish manufacture.**] *Skogsägaren* 18, 1942 (190–2). [Sw.]

A portable kiln of simple construction, designed by C. Skånberg, is used widely in Sweden, Norway and Finland and has proved economically satisfactory. Tar products of high quality as well as producer-gas charcoal are obtained. Logging waste, stumps and large branches are used in the kiln. R. P. J.

33.37–8. **Timber as a source of gas.** *Iron Coal Tr. Rev.* 147, 1943 (798). O.B.

It is reported in the monthly bulletin of the Schweizerischer Verein von Gas- und Wasserfachmännern that in trials conducted at Berne gasworks in 1942, a mixture of one-third hardwood and two-thirds softwood gave 28·8 cu. m. of gas per 100 kg. of wood, with a calorific value of 3,800 cal. per cu. m. at N.T.P., as well as 170 kg. of charcoal.

33.37–8. MILLOT, R. **A solution of the problems of industrial wood distillation in the forest; the Turpin kiln.** *Rev. Agric. Fr.* 73, 1941 (210–1). *Chem. Zbl.* II, 1942 (485). Chem. Abstr. 37 (4552). P.R.

A short discussion of one of the movable kilns constructed by F. Turpin for carbonizing wood in the forest. The oven works continually and permits the recovery of tar and crude acetic acid as well as the production of charcoal; the waste gas from carbonization serves to heat the retort. Erection and operation of the kiln are described. *Ibid.* 300–302.—Plant-scale carbonization investigations with the somewhat revised Turpin kiln for the purpose of greater recovery of by-products are discussed. Investigation of conditions and charge as well as yield of charcoal, tar and crude acetic acid are indicated.

33.38. Charcoal Manufacture. Use of Wood and Charcoal in Producer-Gas Generators

33.38 (82). BALDI, E. Estudio sobre el carbon vegetal en Santiago del Estero. [**Study on charcoal in Santiago del Estero.**] *Publ. misc. Minist. Agric. Argentina* No. 103, 1941. pp. 30. [Span.]

A discussion of the local charcoal industry, which is of considerable importance, though the methods of charcoal production are quite primitive. Suggestions are made for the establishment of a modern distillation plant.

33.38.1 : 07.7. BUDHIRAJA, K. L., and DEY, A. C. **Types of charcoal kilns—I, II, III.** *Indian For.* 69, 1943 (341–51, 381–9). [Forest Research Institute, Dehra Dun.]

The types of pits and kilns used in charcoal manufacture are divided into three main categories:—(1) indigenous kilns. (2) brick-walled kilns, and (3) the metal-type kiln. Indigenous kilns may be further subdivided into the following types, each of which is described:—(*a*) the open pit kiln, (*b*) the improved pit kiln, (*c*) the paraboloidal kiln, (*d*) the oven kiln (including brick-walled ovens), (*e*) the prismatic kiln, and (*f*) the hill kiln. The types of brick-walled kilns dealt with are (*a*) the Nilgiri kiln, (*b*) the conical brick kiln, and (*c*) the Siamese kiln. The only metal kiln receiving mention is the portable charcoal kiln known as 'Frikiln' which has been designed at the Forest Research Institute, Dehra Dun, and is specially adapted for Indian conditions.

33.38.1 : 07.7. DASH, G. C. **Paraboloid charcoal kiln with dry earth covering.** *Indian For.* 69, 1943 (398–400).

At the request of the Conservator of Forests, Orissa, experiments were carried out in 1941 in Angul Division to ascertain whether methods of charcoal manufacture standardized in Sambalpur Division in 1922–3 for the use of shellac factories would be suitable for manufacturing charcoal for producer-gas plants. Two types of paraboloid kiln were used in the introductory experiments:—(1) a 'wet-type' kiln with a mud plaster covering for which water was essential, and (2) a 'dry-type' kiln with a dry-earth covering which required no water. Details are given of the method of constructing the kilns. In order to obtain comparable results, the same species (*Cleistanthus collinus*) and the same size of billets were used in each type of kiln. Both produced good-quality commercial wood-charcoal of similar chemical composition, suitable for producer-gas plants. As, however, water is extremely scarce at some seasons of the year in Angul Division, the 'dry-type' kiln was given preference in further experiments.

In experimental test kilns, 6 to 7 maunds of charcoal have been obtained from 100 cu. ft. of stacked billets, but in practice, with large-scale operations, only 5 to 6 maunds can be expected. The cost of production (including 2 annas to cover supervision and contingencies) is about 9 annas a maund.

33.38.2. '**Charco' gas engines in operation.** *Pulp Paper Mag. Can.* 44, 1943 (745–6).

The author discusses the construction and operation of a producer-gas unit that is manufactured by the Hamilton Bridge Western, Ltd., Vancouver, for use with engines of 100–300 cu. in. displacement. Outstanding features of the unit are that (1) it will start the engine from cold in 60 to 90 seconds; (2) it permits starting on producer gas without the use of any petrol; (3) it is simple to clean and service, and no oil dilution or preignition occurs; and (4) it has a total weight of 250 lb.

33.38.2 (82). COMISION NACIONAL DE GASOGENOS. Organizacion, ejecucion y resultados del primer concurso nacional de gasogenos aplicados a camiones. [**Organization, execution, and results of the first national competitive test of producer lorries.**] *Publ. misc. Minist. Agric. Argentina* No. 154, 1943. pp. 46. [Span.] I.F.B.

A report on competitive tests for lorries operated with different makes of charcoal-gas or wood-gas producer. Under suitable conditions, the use of forest fuels reduces the cost of transport in Argentine by at least 50 per cent.

33.39. Manufacture of Sugar, Oils, Alcohol, and Vinegar from Wood

33.39. BERGIUS, F. (to Holzhydrolyse A.-G.). **Saccharification of compressed ground wood.** *German Patent* No. 712,020, Sept. 11, 1941 (Cl. 89*i*. 1.02). Chem. Abstr. 37 (4571). P.R.

The ground wood used is compressed at 20–100 atm. in such a manner that the volume of the individual particles is reduced.

33.39. BERTHELOT, C. **The hydrolysis of wood cellulose, the aliphatic fermentation of wood sugars and the production of alcohol and ketones for fuel.** *Génie civ.* 118, 1941 (69–75). *Chem. Zbl.* I, 1942 (549). Chem. Abstr. 37 (5859). P.R.

Chemical principles and technical procedure of wood saccharification to obtain motor fuels, especially alcohol

and ketones, by fermentation of wood sugars are described. Meunier's method of saccharification is described in detail, likewise the aliphatic fermentation of wood sugars to fatty acids, which are converted into ketones by the pyrogenic decomposition of the Ca salt or by catalytic conversion in the vapor phase. Hydrolysis of wood has advantages over carbonization for the purpose of obtaining liquid fuels.

33.5. *Pitprops. Sleepers. Poles and Other Roughly Converted Wood*

33.54. EDICK, G. L. **Wooden fences and gates that conserve critical materials.** Bureau of Agricultural Chemistry and Engineering, U.S. Department of Agriculture. 1943. p. [1] + figs. + dgms.

A folder showing types of wooden fences and gates suitable for various farm purposes.

33.54 : 31.27. GIESE, H. **Overturning resistance of wood fence posts.** *Agric. Engng., Mich.* 24, 1943 (151–4). L.S.

A series of tests were made of the overturning resistance of fence posts, 2½, 3, 3½ and 4 in. in diameter, in order to determine the optimum depth of setting to develop the strength of the post. Under the soil and moisture conditions prevailing a balance between post strength and soil resistance was reached when depth of set was approximately ten times the diameter of the post. Experimental equipment and technique are described in detail.

33.8. *Other Manufactured Products*

33.8 : 12.25 (94). AUSTRALIA. **Council for Scientific and Industrial Research. Division of Forest Products. Annual report, 1942–43.** [Melbourne, 1943?] pp. 17 + [3].

Properly selected and treated material of Queensland Kauri (*Agathis* sp.) and Hoop Pine (*Araucaria cunninghamii*) can be used satisfactorily for battery separators, the majority of which are made from these timbers in Australia. Other suitable timbers are Celery-top Pine (*Phyllocladus rhomboidalis*) and King William Pine (*Athrotaxis selaginoides*) (p. 8).

34. MINOR FOREST PRODUCTS AND THEIR UTILIZATION

34.2. *Vegetable Products*

34.23. Wood Ash. Potash

34.23 : 33.06 : 12.26–8 (54). VARMA, B. S., and DEY, A. C. **Ash content of some Indian fuel woods.** *Indian For. Leafl.* (*Chemistry and Minor Forest Products*) No. 28, 1942. pp. 5.

The method used in determining ash values is described, and the ash content is recorded for 65 species of fuel woods, the figures being based on the analysis of some 1,200 samples.

34.24. Tanning Materials. Cork

34.24 : 12.26–8. BURKLAND, E. R. **Divi-divi offers tannin.** *Agric. Amer.* 3, 1943 (154–6). Hort. Abstr. 13 (1531).

The pods of Divi-divi (*Caesalpinia coriaria*) contain 40–50 per cent. tannin. Cultivated under favourable conditions the tree will bear fruit before its 8th year, and will yield 150–300 lb. in a season. In its wild state it flourishes chiefly along the Caribbean coast from sea level up to 600 ft. The most extensive plantings in tropical America have been on Curaçao where experimental work has also been carried out.

34.24 : 12.26–8 (82) : 34.6. GUENNARD, R. G. M. Utilización de tanino de calden para mejorar diversos curtidos. **[Utilization of the tannin of Calden for improving various leathers.]** *Maderil* 16 (181), 1943 (8). [Span.]

In his experiments the author obtained a good yield of high-quality tannin extract from the sawdust of this species of *Prosopis*. Calden sawdust and other mill waste is available in large quantities in Argentine.

34.24 : 12.26–8. QUINONES, L. R., and PUNCOCHAR, J. F. Informe preliminar sobre la utilizacion practica de la corteza del mangle. **[Preliminary information on the practical utilization of Mangrove bark.]** *Carib. For.* 5, 1943 (44–7). [Span.e.]

From preliminary tests with the bark of *Rhizophora mangle* it appears that Mangrove tannin may serve as a local substitute for Quebracho extracts, the importation of which has become difficult as a result of the war.

34.24 : 12.26–8 (44). RAZOUS, P. **The use of Oak bark in tanning and the manufacture of tanning extracts.** *Génie civ.* 119 (17), 1942 (205–8). Chem. Abstr. 37 (4927). P.R.

Good Oak bark, from trees not more than 18 years old, yields approximately 10 per cent. tannin. A review is given of drying methods and extraction, with drawings of equipment used for cutting bark and for extracting tannin. Possibilities of tanning agents from various other trees and vegetables are suggested; Mimosa contains 34 to 35 per cent. tannin.

34.24 : 12.26–8 (72 : 728 : 729 : 75.8–9 : 76.1–4 : 8) : 21.3 : 12.11.2. RUSSELL, A. **Chestnut extract substitute.** *Oil Paint Drug Rep.* 143 (12), 1943 (7). [Univ. of North Carolina.] L.S.

Buttonwood (*Conocarpus erecta*), which occurs in the subtropical United States, Mexico, Central America, South America, and the West Indies, offers a practical source of natural tannin; this is present in the wood (about 8 per cent.) and the bark (about 20 per cent.), both of which leach easily. In use the extract compares favourably with commercial Quebracho and Chestnut extracts. Preliminary tests indicate that leached Buttonwood chips can be used for paper making, although the pulp is dark and difficult to bleach.

In its natural range *C. erecta* is found on saline soil near the coast, but experiments have shown that it is adaptable to inland sites; it grows rapidly and regenerates naturally from both seed and root suckers.

34.25. Medicinal Plants. Edible Plants

34.25 : 12.26–8 : 22.22. ARNST, A. **Cascara bark goes to war.** *Soil Conserv.* 9, 1943 (102–5).

The problem of destructive harvesting of the bark of Cascara Buckthorn (*Rhamnus purshiana* De Candolle) has led to the issue of a propaganda poster by the Soil Conservation Service of the U.S. Department of Agriculture which deals with the proper management of Cascara exploitation. Chief among the harvesting abuses is the practice of stripping trees and leaving them standing. Cascara sprouts freely from stumps provided that the peeled tree is felled; the growing of coppice stands is the cheapest and easiest way of maintaining an adequate supply of bark.

34.25 : 12.14.5 : 12.25. SCHICK, B. **A tea prepared from needles of Pine trees against scurvy.** *Science* 98, 1943 (241–2). L.S.

Some examples are given from older literature of the beneficial effects of Pine needles in the treatment of scurvy and in preventing the occurrence of this disease. A tea prepared by pouring boiling water over crushed Pine needles is said to be very palatable.

34.25 : 12.14.5 : 12.25. MACNAMARA, C. **Vitamin C in evergreen-tree needles.** *Science* 98, 1943 (242). L.S.

Reference is made to the unidentified evergreen tree (Ameda) which is reputed to have cured Jacques Cartier's men of scurvy when they wintered near Quebec in 1535–6. As Spruce and Hemlock were both used by the native Indians for medicinal purposes, it is possible that either of these species may have been the source of the remedy. [See also *Science* 98, 1943 (132).]

34.25 (82) : 12.26–8 : 12.19. O'DONELL, C. A., and RODRÍGUEZ, J. M. Les plantas medicinales del Noroeste Argentino. II. **[The medicinal plants of the Argentine Northwest. II.]** *Rev. Farm., B. Aires* 84, 1942 (149–59). [Span.] [Inst. Miguel Lillo.] Biol. Abstr. 17 (22494).

A pharmacognostical compilation including the following data:—botanical origin; part of the plant used as medicine; characteristic features; geographical distribution; and herbarium specimens examined. *Lithraea molleoides* and *Schinus molle* var. *areira* are among the species considered.

34.25 (82) : 12.26–8. O'DONELL, C. A., and RODRÍGUEZ, J. M. Plantas medicinales del Noroeste Argentino III. **[Medicinal plants of the Argentine Northwest. III.]** *Rev. Farm., B. Aires* 84, 1942 (201–11). [Span.] [Inst. Miguel Lillo.] Biol. Abstr. 17 (22494).

Zizyphus mistol and *Schinus polygamus* are among the species discussed.

34.25 : 12.14.7 : 12.26–8. BRAUDE, R. **Value of horse chestnuts as food for pigs.** *Nature, Lond.* 152, 1943 (571–2). [University of Reading.]

Tests have shown that pigs will not eat raw horse chestnuts, either in their original state or after being crushed. In further experiments, horse chestnuts prepared by (1) drying and grinding, (*b*) boiling, or (*c*) soaking in cold water, were included as part of a fattening diet: it was found that decorticated, soaked chestnuts could replace as much as 20 per cent. of the wheat feed in a balanced fattening meal. However, none of the methods used in the preparation of the chestnuts could be recommended for practical application.

34.26. Resin. Gums. Turpentine. Oils. Rubber. Latex. Dyestuffs. Sugar

34.26. BORGLIN, J. N., MOSHER, P. R., NOBLE, B., and PUNSHON, T. **Rosin—use in soap.** *Oil and Soap* 20, 1943 (77–84). [Hecules Exp. Sta., Wilmington, Delaware.] P.O.

Experiments were made to determine the effect of using wood rosin and Staybelite (hydrogenated rosin) in the manufacture of soap.

34.26 (4). Kadtappning och kådsamling. **[Resin tapping and resin collection.]** *Skogen* 30, 1943 (85). [Sw.]

Owing to the scarcity of certain raw materials in a number of countries, a fresh impetus has been given to the extraction of resin. Resin tapping has been practised for many years in Germany, the trees being specially treated for the purpose. The amount obtained is approximately 17,000 tons a year. It has also been practised to a certain extent in Sweden, and on a large scale by the Russians in Karelia. R. P. J.

34.26 (73). HUMPHREY, I. W. **Solvent refining of wood rosin.** *Industr. Engng. Chem.* (*Industr. Ed.*) 35, 1943 (1062–7). L.S.

In recent years 40–50 per cent. of the total United States rosin production has been obtained by extracting wood rosin from the stumps of the cut-over Pine lands of the southern states. The refining of crude wood rosin for commercial use was made possible by treatment with furfural using a dual, immiscible solvent process. Other types of solvents for rosin colour bodies are discussed as well as the selective solvent refining of the rosin derivatives.

34.26 : 01.4. HESSENLAND, M. **Rosin from trees.** *German Patent* No. 712,267, Sept. 18, 1941 (Cl. 22*h*. 1.01). Chem. Abstr. 37 (4588). P.R.

A tree is incised and the incision treated with a chemical irritant. After tapping, the wound is bathed with H_2O or a neutralizing substance.

34.26 : 01.4. NAJERA Y ANGULO, F. Estudio sobre los perfeccionamientos de que es susceptible el sistema de resinacion hugues. **[Study on possible improvements in the Hugues method of resin collection.]** [*Publ.*] *Inst. for. Investig. Exp., Madrid* 13 (25), 1942. pp. 47. Span.port.g.f.e.]

The chief drawbacks of the Hugues system are:—(1) rainwater penetrates into the collecting pots, soils the resin, and often causes it to run over; (2) the resin evaporates and oxydizes where the pots are not covered, with consequent loss of turpentine oil and a deeper, commercially disadvantageous, colouring of the colophony. Suggestions are made for the use of covered pots in combination with a zinc-plate water shed fixed above the blaze, and the advantages of this system for the Spanish resin industry are discussed.

34.26 : 12.11.11 : 12.25. SCHEUBLE, R. Das sogenannte Erstlings- oder Jungfernharz und die jahreszeitlichen Schwankungen der Harzeigenschaften bei der Weiss- und Schwarzkiefer. **[The so-called primary or virgin resin and the seasonal variations in resin properties of *Pinus sylvestris* and *P. nigra*.]** *Cbl. gesamte Forstw.* 68, 1942 (215–21). [G.]

In the small-scale tests described it was found that the chemical and physical properties of primary resin (obtained immediately after the first tapping of the year) differed very little from those of resin obtained later in the season.

34.26 : 12.25 (72). CID Y BERGMAN, M. La resinacion como una industria de porvenir para Mexico. **[Resin production as a future industry for Mexico.]** *Bol. bim. Direc. For. Caza. Mexico* 3 (2), 1942 (21–4). [Span.]

The author notes the existence in Mexico of a number of Pine species that might allow of resin tapping on a commercial scale, including *P. leiophilla, P. chihuahuana, P. teocote, P. hartwegii, P. montezumae, P. ponderosa, P. coulteri*, and *P. arizonica*. The technique of resin production is explained briefly.

34.26 : 12.25. WESTGATE, M. W. **Brief notes on Pinyon resin and stick lac from Arizona.** *Circ. Nat. Paint Varnish Ass.* (*Sci. Sect.*) No. 665, 1943 (190–8). Biol. Abstr. 18 (1609).

Varnish made with the resin of the Piñon Pine (*Pinus edulis*) has markedly superior resistance to hot and cold water than ordinary rosin. This valuable property suggests the use of Piñon Pine resin with linseed oil to offset the shortage of Tung oil in the production of highly water-resistant varnishes.

34.26 : 12.25–8 (67.5) : 31.3. ADRIAENS, L. **Chemistry of several gums from the Belgian Congo.** *Mem. Inst. roy. colon. Belgè* (*Sect. sci. nat. méd.*) No. 8, 1939 (1–100). Chem. Abstr. 37 (4926). P.R.

Gums from six different trees are described and discussed, and analyses are given for moisture, ash, water-soluble material, galactose (I), pentosans, reducing sugars, and reducing sugars of the 'mucilage' component. The main constituents obtained by hydrolysis of the gums are:—*Acacia farnesiana*, I; *A. sieberiana*, I, arabinose (II), fucose and xylose; *Albizzia gummifera*, I and II; *Cedrela odorata*, I; *Grevillea robusta*, I and II; 'Lagi' (scientific name not known), I.

34.26 (54) : 12.26–8. BAL, S. N., and PRASAD, S. **Indigenous substitutes for imported drugs.** *Indian J. Pharm.* 5, 1943 (30–6). Chem. Abstr. 37 (5829).

Possible substitutes for several drug plants commonly imported into India are discussed. Gums from *Astragalus strobiliferous* Royle, *Sterculia urens*, *Cochlospermum gossypium* or *Bombax malabaricum* can be substituted for gum tragacanth from *A. gummifer* Labill., and gum acacia from *Acacia indica* or *arabica* for that from *A. senegal* and *Ferula foetida*. Other possible substitutions are discussed.

34.26 : 12.26–8. RANGEL, J. L. **Angico gum.** *Rev. quím. ind., Rio de J.* 12 (16–18), 1943 (128–30). Chem. Abstr. 37 (6055). P.R.

Descriptions are given of the various species of *Piptadenia* from which this gum is obtained, and their uses for technical purposes are discussed. The gum, which is used medicinally and as an adhesive, is chemically similar to gum arabic, but is of inferior quality owing to the primitive methods of collection and packing.

34.26 : 12.25 : 12.11.11. SCHEUBLE, R. Die ungewöhnliche Zusammensetzung der Terpentinöle von *Pinus sabineana* und *jeffreyi*. [**The unusual composition of the turpentine oils of *Pinus sabiniana* and *P. jeffreyi***.] *Cbl. gesamte Forstw.* 68, 1942 (64–9). [G.]

Only two species of *Pinus* (*P. sabiniana* and *P. jeffreyi*) are known to produce resin whose volatile oil content is made up chiefly of heptane (C_7H_{16}) in place of the usual pinene ($C_{10}H_{16}$) or related hydrocarbons produced by other species of Pine. In no case do terpene and heptane occur together. *Pinus ponderosa*, although closely resembling *P. jeffreyi* botanically, produces only turpentine oils of the usual type containing no heptane. Volatile oils produced by *P. jeffreyi* and *P. ponderosa* in the experimental garden of the Viennese Hochschule für Bodenkultur were shown to be essentially similar in composition to those produced by the same species in California. Resins from native Californian *P. sabiniana* and *P. jeffreyi* are reported to contain 4·2 to 11·4 per cent. of oil by weight. The specific weight of the oil has been fixed at 0·677 to 0·771; the boiling point is generally between 97 and 100°, and the heptane content of the oil is 89 to 98 per cent.

34.26 (73) : 12.25. PALMER, R. C. **Solvents from Pine.** *Industr. Engng. Chem.* (*Industr. Ed.*) 35, 1943 (1023–5). L.S.

The important methods of producing Pine solvents, in descending order of volume production, are:—(1) extraction from dead wood; (2) collection of oleoresin from the living tree; (3) recovery of terpenes as a by-product of pulp production; (4) destructive distillation. Notes are given on the characteristics, uses and American production of turpentine, dipentrene terpenes, Pine oil, fatty acids, destructive distillation products, rosin oils, and isoprene.

34.26 : 12.14.7 : 12.25 (76.9). GLAZOFF, S. DE, and KOLACHOV, P. J. **Comparison of assays of domestic and imported aromatic plants and essential oils.** *Trans. Ky. Acad. Sci.* 10 (1/2), 1942 (13–8). L.S.

Results are given of investigations on the oils produced by Kentucky-grown *Coriandrum sativum*, *Angelica archangelica*, *Lavandula vera*, and *Juniperus communis*. The commercially important part of Juniper is the berry containing the essential oils, the main constituent of which is alpha pinene. Other constituents are cadinene, camphene, terpinene, borneol, and isoborneol. Because most of the components are terpenes, Juniper oil is particularly unstable. The oil of ripe berries is already partly changed into a resin, while that of over-ripe fruit is almost completely resinified. The amount of oil is greatest in berries which have attained their full growth but are still green. The quality of the oil from green berries is, however, inferior. The oil content tends to be higher in wild plants than in the cultivated varieties, but the quality seems to be almost in reverse proportion to the amount of oil. In some cases the flavour of the oil can be improved by dilution. There is room for further research in improving the quality of Juniper oils in Kentucky.

34.26 : 33.37. LEVESQUE, J. (to The Province of Quebec, Department of Colonization). **Extraction and purification of oils from hardwood tar.** *U.S. Patent* No. 2,313,385, March 9, 1943. Chem. Abstr. 37 (5226). P.R.

34.26 (941) : 12.25–8. GUENTHER, E. S. **West Australian essential oils: a survey.** *Drug Cosmetic Ind.* 53, 1943 (270–1, 275, 277, 393, 452–6). L.S.

An account is given of the synonomy and distribution of *Santalum spicatum* (= *Fusanus spicatus*), of the cutting, collection and distillation of the wood, and of the physico-chemical properties, chemical composition and uses of Sandalwood oil. Notes are given on the oils of *Boronia megastigma*, *Araucaria* sp., *Callitropsis araucarioides* and *Dacrydium franklinii*.

34.26 : 12.26–8 (54.87). CHILD, R., and NATHANAEL, W. R. N. ***Hydnocarpus* oils in Ceylon.** *Trop. Agric., Ceylon* 98, 1942 (2–7). L.S.

As the oil of *Hydnocarpus wightiana* is better suited for medicinal purposes than that of other species it is desirable that the plant should be cultivated in Ceylon on a sufficient scale that the required supplies may be forthcoming.

34.26 : 12.26–8 : 12.14.7. STELDT, F. A., and CHEN, K. K. **An investigation of the oil of *Cerbera odollam*.** *J. Amer. pharm. Ass.* (*Sci. Ed.*) 32, 1943 (203–4). [Lilly Research Laboratories, Indianpolis, Ind.] L.S.

34.26 : 12.26–8. SCHUETTE, H. A., VOGEL, H. A., and BAIN, J. A. **The saturated fatty acids of Elderberry seed oil.** *Oil and Soap* 20, 1943 (46). [Univ. of Wisconsin, Madison, Wis.] P.O.

34.26 : 12.26–8 : 45.3. SOUZA MACHADO, A. A. DE. A essencia de inhamuí, novo insecticida da flora brasileira. [**The essence of *Nectandra oleophorum*, a new insecticide from the Brazilian flora.**] *Bol. Ministr. Agric., Rio de J.* 30 (5), 1941 (33–5). [Port.]

The chemical, physical, and insecticidal properties of this essential oil are discussed. It is especially useful in the control of aphids.

34.26 : 12.26–8. MARTIN, G. **Competitive rubber plants.** *Nature, Lond.* 153, 1944 (212–5).

A review of some of the more important rubber-bearing plants of the world, with indications as to the quality of their latex, the possibility of their use in the present emergency, and the prospects of their economic development after the war. Trees which have to go through the same cycle of operations as *Hevea brasiliensis* are not likely to compete successfully with that species after the war as they are generally inferior to it in the yield, quality, and ease of treatment of their latex. Small plants, however, such as Kok-saghyz, may be capable of competition with *Hevea* in the future owing to the fact that their cultivation and treatment can to a large extent be mechanized, although their yield of rubber is not at present good enough to enable them to hold their own in a strictly competitive market.

Some of the plants mentioned in this article contain a large percentage of vegetable resins mixed with their rubber hydrocarbons, so that the unpurified latex is soft and difficult to vulcanize. In such cases it is often advantageous to use the unpurified product for purposes for which its limited properties are suitable, since the cost of purification may be prohibitive. In addition to *Hevea* and Kok-saghyz, the following rubber-bearing plants are briefly discussed:—*Euphorbia tirucalli, Carpodinus hirsuta, Ficus vogelii, Parthenium argentatum, Cryptostegia grandiflora, Funtumia elastica, Manihot glaziovii, Ficus elastica*, and species of *Landolphia* (particularly *L. thollonii*), *Clitandra*, *Carpodinus*, and *Castilla*.

34.26 (54) : 12.26–8. **Indian indigenous dyes: babul and cutch and their application.** *Indian Text. J.* 53, 1943 (295–6). P.O.

A short account is given of the colouring principle (tannins) obtained from Babul (*Acacia arabica*) and its use, and of the sources, extraction and application of the colouring material cutch, which is obtained from various species of *Acacia*.

34.26 : 12.26–8 : 12.11.22. **Increasing the sugar content of Sugar Maples.** *J. For.* 41, 1943 (922).

Investigations are being made into the possibilities of growing Sugar Maples (*Acer saccharum*) with a higher percentage of sugar than the average. In attempts to propagate Maples by cuttings best results were obtained with June cuttings from old trees, planted in an indoor shaded bed and sprinkled frequently with water.

34.26 : 12.26–8 : 45.11. SEARS, P. B. **Grazing versus Maple syrup.** *Science* 98, 1943 (83–4). [Oberlin College.] L.S.

Sugar Maple (*Acer saccharum*) trees protected from grazing are reported to have given a noticeably higher yield of syrup per tree over a long period than trees in neighbouring groves which remained pastured.

34.27. Seeds. Fruits. Leaf Fodder. Fibres and Flosses

34.27 : 12.26–8. **Ölsaatenrückstände als Futtermittel. [Residue of oil seeds as feedingstuffs.]** *Mitt. Landw. [Berlin]* 58, 1943 (100–1). [G.] Herb. Abstr. 13 (1103).

Sunflower seed meal and Beech mast cake and meal are discussed. A good harvest of Beechnuts can be expected only once in every four to seven years. A harvest of this nature was available in the autumn of 1942, and large quantities of nuts were taken to the oil mills for the removal of the fat. The residue was made into Beechnut cake containing approximately 13 per cent. digestible crude protein and 32 kg. starch equivalents in 100 kg., and Beechnut meal containing approximately 14 per cent. digestible crude protein and 26 kg. starch equivalents in 100 kg. Beechnuts contain a poison injurious to horses, mules and donkeys, but they are useful in moderate quantities for other animals and poultry, although not described as of high nutritive value.

34.27 (67.6). BECKLEY, V. A. **Some indigenous vegetable fibres.** *E. Afr. agric. J.* 9, 1943 (76–80). [Department of Agriculture, Kenya.]

A general account is given of the vegetable fibres that are, or could be, produced in East Africa.

34.6. *Utilization of Logging and Milling Waste*

34.6. BROWN, N. C. **Progress in salvaged logging and sawmill waste.** *Timber of Canada* 4 (1), 1943 (60–5, 160, 162). [New York State College of Forestry at Syracuse University.]

The more important developments towards reducing logging and sawmill waste in the United States are discussed. These are:—(1) the installation of pulp and fibre board mills to utilize woods and sawmill waste; (2) increased use of Swedish gang sawmills and of band saws in small portable mills; (3) lower stumps and increased use of top logs; (4) increased use of slabs, edgings and other sawmill waste in various manufactured products; (5) the installation of box board and crating factories in connexion with sawmills; (6) increased use of hardwood dimension stock; (7) use of sawmill and wood waste as fuel; (8) many uses for sawdust including plastics; (9) uses for bark; (10) uses for shavings; and (11) reduced losses in the manufacture of sleepers.

Conditions in Europe that favour a relatively close utilization are (*a*) a small number of tree species, (*b*) small trees, (*c*) the use of lumber with small, sound knots, (*d*) the existence of a large number of small, permanently located gang-sawmills, and (*e*) an excellent and permanent road system.

34.6 : 33.32. DEICHMÜLLER, F. Die Verwertung von Holzabfällen bei der Herstellung von Faserstoffplatten. [**The ultilization of wood waste in the production of fibre boards.**] *Dtsch. Holzbau* 3, 1943 (116–8). [G.]

Brief review of patents, mainly German.

34.6 : 33.06 : 07.7. HARRIS, P. **The utilisation of wood waste as fuel.** *Fuel Econ. Rev.* 22, 1943 (30–3). [Forest Products Research Laboratory, Princes Risborough, Bucks.] P.R.

An illustrated account of the construction and operation of types of furnaces in which wood waste in its various forms can be burned efficiently.

38. FOREST CONSTRUCTIONAL WORKS. ENGINEERING

38 : 07.7. **Ett nytt hjälpmedel för stenröjning. Svensk-byggd, transportabel bergborrmaskin löser ett gammalt problem. [A new implement for rock clearing. A**

portable rock drill of Swedish construction solves an old problem.] *Skogsägaren* 18, 1942 (192). [Sw.]

The Warsop rock drill is a self-contained implement, the motor being enclosed in the unit. Purchase and running costs are low, the drill is easy to operate and it gives good results. R. P. J.

38.1 : 33.16. GREAT BRITAIN. **War emergency British standard specification for wood wool building slab No. 1105–1943.** British Standards Institution, London. 1943. pp. 5. Build. Sci. Abstr. 16 (*n.s.*), 1943 (584). P.R.

The specification covers (*a*) normal quality slabs, especially suitable as thermal insulation, (*b*) special quality slabs, intended more particularly for roof and floor construction or for permanent shuttering, and (*c*) reinforced slabs, reinforced longitudinally with light timber battens, and suitable for roof construction. The slabs, which must consist essentially of wood wool and an inorganic cementing agent mechanically pressed together, shall be 72 in. long by 24 in. wide with thicknesses of either 1, 1½, 2 or 3 in. Weights, transverse strengths, and maximum deflections under test load are specified for each class of slab. Appendix A describes the method of measuring thickness of slabs, Appendix B specifies the test for transverse strength, while Appendix C gives some advice on the use of wood wool building slabs.

38.2. **Heavy timber construction details.** National Lumber Manufacturers Association, Washington, D.C., U.S.A. 1943. pp. 16.

38.2. BOUGHTON, R. V. **Simple structural design. XIII. Timber cantilevers.** *Ill. Carp. Build.* 132, 1943 (1428–9). P.R.

Formulae are given for bending and deflection in cantilevers and continuous beams of various timbers under different conditions of loading.

38.2 : 31.27. AUSTRALIA. **Council for Scientific and Industrial Research. Division of Forest Products. Annual report, 1942–43.** [Melbourne, 1943?] pp. 17 + [3].

Following a number of failures in the tension joints of Pratt roof trusses, investigations are being made on the effect of long-time loads on the strength of timber-connector joints. With green hardwood the strength of these joints has been found to be much lower than was expected from previous tests made with short-time loads. Tests indicate that in order to develop the full strength of the joint in green hardwood the end distance for a 2½-in. ring should be 8 in. (p. 5)

38.6 : 33.36.1. **Wartime constitution of creosoted culverts, drain boxes and sewers.** *B.C. Lumberm.* 27 (10), 1943 (62).

38.62 : 74. SAARI, E. **Estimating the economic value of forest draining.** *Acta for. fenn.* 50 (16), 1942 (1–40). [Finn.g.] S.P.S.

It is difficult to fix the economic value of draining in exact figures. The method best adapted for unstocked areas is to calculate the soil value before and after draining, using Faustmann's formula, and compare the difference with the cost of draining. For productive areas, the general method is to calculate the expectation value before and after draining, and again compare the difference with the cost of draining. It is to be noted that the economic effect of draining is not generally limited only to the drained area.

38.8 : 33.36.1. **Creosoted wood ditch checks of large size.** *Wood Pres. News* 21, 1943 (118, 123). P.R.

4. FOREST INJURIES AND PROTECTION

4 : 12.25. TIKKA, P. S. **The importance of damage in the Pine forests of northern Finland.** *Acta for. fenn.* 50 (1), 1942 (1–91). [Finn.g.] S.P.S.

This article reports on a sample-plot study of various types of damage in Pine stands in northern Finland; suggestions are made for the improvement of timber quality by the use of silvicultural methods.

41. GENERAL PROTECTION AGAINST FOREST INJURIES

41 (82) : 23.3. Necessidad de proteger las masas boscosas en la Prov. de Bs. Aires. [**Necessity of protecting woodlands in the Province of Buenos Aires.**] *Maderil* 15 (176), 1943 (29–30). [Span.]

Legislation and administrative action are contemplated for the protection of existing forest resources and for the organization of public and private afforestation work.

42. INJURIES FROM INORGANIC AGENCIES, EXCLUDING FIRE

42.1. *Air Currents*

42.1 (74.4 : 74.6) : 11.12. CURTIS, J. D. **Some observations on wind damage.** *J. For.* 41, 1943 (877–82). [Univ. of Maine, Orono, Maine.]

The author reviews briefly the literature on wind behaviour and wind occurrence in relation to forest stands, and gives an account of a study undertaken in Massachusetts and Connecticut after the 1938 hurricane with the purpose of relating forest conditions and wind damage. This work and the experience of other investigators indicate certain principles, the application of which in future silvicultural operations, making due allowance for local conditions, should help lessen the damage of forests by wind in New England.

42.2. *Temperature Influence*

42.21 : 12.25 : 23.24.1. TYRON, E. H. **Stem girdling of coniferous nursery stock by frost-heaved soil.** *J. For.* 41, 1943 (768–9).

Girdling of the stems of seedlings of certain western American conifers has been observed as a result of the mechanical action of frozen nursery soil. This type of injury usually occurs in the autumn and the seedlings die during the following growing season. The 1 + 0 plants appear to be more susceptible to the injury than either 2 + 0 or 2 + 1 plants.

42.21 (74) : 12.25. HUBERMAN, M. A. **Sunscald of Eastern White Pine, *Pinus strobus* L.** *Ecology* 24, 1943 (456–71). [Northeastern Forest Exp. Sta.]

Eastern White Pine trees (*Pinus strobus*) situated on the edge of cuttings frequently show injury in the form of dead strips of bark on their sun-exposed sides. Although seldom serious enough to kill the tree, such injury causes degrade of logs, often making them unmerchantable, and provides an entrance for fungi and

wood-boring insects which may endanger not only the individual tree but the whole stand. The average injured tree is between 4 and 10 in. in diameter and between 31 and 51 years of age, and has a dark-coloured smooth bark 3·7 to 7·5 mm. thick. The wound generally occurs on the south-west side of the tree in New England, and appears to be a winter injury probably due to rapid freezing of the cambium. Sunscald can be avoided by making the smallest possible openings consistent with sound silviculture in harvest and improvement cuttings and by leaving 'screen' trees on the southern and western borders of woodlots.

42.21 (74.1) : 12.26–8. NASH, R. W. **Winter killing of hardwoods.** *J. For.* 41, 1943 (841–2). [Maine Forest Service.]

Severe damage of hardwoods is reported from Maine following lowest recorded temperatures in certain regions during the winter of 1943. All sizes of trees were injured, but particularly the smaller trees, and injury occurred generally on low areas near lakes and streams and on flat areas at low altitude. Thinning and cleaning did not appear to have influenced the severity of injury.

The species most severely injured was Beech, followed by White Oak; White Ash, Red Maple, and Witch Hazel were commonly injured.

Growth on the upper parts of the trees of Norway Spruce and Colorado Blue Spruce was retarded as a result of cold injury.

42.21 : 12.26–8 : 44.3 : 12.21. CRANDALL, B. S. **Bacterial infection and decay of the inner wood of winter-injured young London Plane trees.** *Phytopathology* 33, 1943 (963–4). [U.S. Bureau of Plant Industry.]

Five-year-old London Plane trees (*Platanus acerifolia*) in a Maryland nursery were observed in 1934 to be showing frost cracks, and the following summer it was noticed that pruning wounds were not healing properly on many of the trees. Examination of the apparently unhealthy trees revealed that the three innermost annual rings above the snow line of the winter of 1931–2 (5 in. from the ground) were discoloured and water-soaked. The water-soaked condition, resembling slime flux, reached the surface of open pruning wounds, apparently preventing callusing, and allowed the entrance of a rot fungus resembling *Polyporus versicolor*. From the wet, discoloured inner wood Gram-negative, $0{\cdot}25 \times 0{\cdot}5\ \mu$, rod-shaped bacteria were consistently isolated. Examination of some of the survivors of the original group of trees several years later showed the water-soaked condition still limited almost entirely to the innermost three rings. It is believed that the temperature conditions of the preceding winters were largely responsible for the phenomenon.

42.3. *Precipitations*

42.32 : 12.25. BARTH, A. **Damage in Spruce forest caused by snow pressure and the treatment of damaged stands.** *Tidsskr. Skogbr.* 1942 (85–93, 137–51). [Nor.] S.P.S.

The author reviews earlier experience and gives an account of his own investigations on this subject. Trees with broken tops need not be removed from the stand for fear of rot provided that the diameter at the point of breakage does not exceed 4–5 cm., or that the remaining crown is 7–8 m. or more in height and the diameter at the point of breakage is not large.

42.32 : 12.25 : 21.61. MIKOLA, P. **The form of the crown and trunk of snow damaged Spruce in the Maamselkä area of Finland.** *Silva fenn.* No. 47, 1938 (1–36). [Finn.g.] S.P.S.

From a study of 47 sample Spruce trees exposed to snow damage in an area in northern Finland, the author found that near the ground the crowns of the trees were very wide and the stems had large butt swellings. From a height of 4–5 m. upward the crowns were thin and almost cylindrical and the stems had a marked taper.

42.32 : 12.25 : 12.11.3 : 21.61. RUBNER, N. Die Gefährdung der Fichte durch Schnee- und Rauhreifbruch. **[The damage to Spruce through breakage by snow and rime.]** *Mitt. H.-Göring-Akad. dtsch. Forstwiss.* 2 (1), 1942 (211–22). [G.] *Abstr.* in *Forschungsdienst* (*Schriftum*) 15, 1943 (69). A.P.B.

A comprehensive presentation of our present knowledge of damage to Spruce through breakage and of the closely allied question of Spruce provenance in the German Mittelgebirge. A decisive factor in damage through stem breakage is the crown form, which varies in the two, or probably three, races of Spruce distinguished by height differences.

42.5. *Chemical Influences. Nutrient Deficiencies*

42.5 : 12.25 : 21.3. SMITH, M. E. **Micronutrients essential for the growth of *Pinus radiata*.** *Aust. For.* 7, 1943 (22–7). [Univ. of Western Australia.]

Pine (*Pinus radiata*) seedlings were grown in culture solutions deficient in one of each of the minor elements zinc, manganese, copper, molybdenum and boron, and results were compared with those for controls grown in full nutrient solutions.

Symptoms of zinc deficiency developed within two months of planting and soon became pronounced. Manganese deficiency led to very severe injury of a characteristic nature, while lack of copper caused less severe but distinctive symptoms to develop gradually. Molybdenum-deficient seedlings grew well but gave indications of a gradual disturbance of the metabolism. Injury due to boron deficiency developed slowly but the final symptoms were characteristic and quite severe.

42.6. *Electrical and Cosmic Influences*

42.61 (73) : 12.25–8. THOMSON, A. R. **Lightning struck tree survey.** *Proc. 18th nat. Shade Tree Conf.* 1942 (192–200). [Lightning Struck Tree Survey, Chicago, Ill.]

Data obtained from a six-year survey of lightning-struck trees in the United States, undertaken by the National Shade Tree Conference and still continuing under its auspices, show that Oak, Elm, Poplar, Tulip-tree, Ash, Pine, and Maple are struck more frequently than other species. Slightly over half of the struck trees stood alone or were taller than their fellows. Eighty-two per cent. were more than 50 ft. in height, while 64 per cent. were above 60 ft.

43. FOREST FIRES

43. SHAW, E. E. **Forest fires: how they start and how they are fought.** *Pulp Paper Mag. Can.* 44, 1943 (591–4).

Following a brief reference to the main causes of forest fires, the fire hazard index, and methods of fire detection and communication, an illustrated description is given of various types of forest fires, with notes on the principles of fire fighting.

43 (82). TORTORELLI, L. A. Los incendios de bosques en nuestro país. [**Forest fires in our country (Argentina).**] *Maderil* 16 (181), 1943 (12–6, 27). [Span.]

Forest fires in Argentina are due to a variety of causes, among the most important being the burning of forest in connexion with clearing for agricultural cultivation and the burning of pasture. In the case of Patagonia the fires almost invariably start on Chilean territory and spread across the border. While intensive protection and control are considered impracticable for the time being, it is suggested that, as an immediate measure, the staff of the Argentine forest police should be enlarged and given adequate training in fire protection and control, and also that a close collaboration in fire protection be secured between the forest authorities of Argentina and Chile. Preliminary agreement has already been reached in this respect.

43 (485). RISBERG, G. E. Skogseldar och brandskydd 1942. [**Forest fires and fire protection in 1942.**] *Skogen* 30, 1943 (17–9). [Sw.]

The number of forest fires reported in Sweden during 1942 was within the 500–700 limit; in addition a large number of fires occurred along railway lines. The area of forest land burned over was less than in 1940 and 1941. The highest monthly record of fires was in May.

Throughout the country there are at present 70 wooden fire towers and about 180 modern steel towers. As an aid to fire protection, propaganda and educational programmes are being carried out by various organizations.

43.0. *Predisposing Factors and Causes*

43.01–2 : 11.15. BYRAM, G. M., and JEMISON, G. M. **Solar radiation and forest fuel moisture.** *J. agric. Res.* 67, 1943 (149–76). [Appalachian Forest Exp. Sta.] O.R.E.

This study of solar radiation and forest fuel moisture was undertaken with a view to improving fire-danger rating systems, which, as used at present in the United States, are based chiefly on measurement of wind and of fuel moisture. A method was developed whereby radiation intensity can be determined for any season of the year, hour of day, slope, and aspect. The relation of solar radiation intensity to surface fuel moisture equilibria and, to a lesser extent, its relation to rates of drying have been established on the basis of theory and of data obtained by use of a specially constructed apparatus. Formulae have been developed so that for any combination of air temperature, relative humidity, and wind velocity, equilibrium moisture content of forest litter can be derived for any season, slope, and aspect. These formulae can be used universally, provided radiation intensities are adjusted for latitude.

Fuel moisture equilibrium maps are presented showing variations with season, aspect, and slope that result from variations in radiation intensity alone. A table is presented showing differences in drying rates caused by differences in radiation. *From authors' summary.*

43.1. *Protective Measures*

43.1. CORNWALL, G. F. **Smoke jumpers: forest fire paratroops.** *Timberman* 45 (1), 1943–44 (10–3, 44).

Parachute jumpers are being used extensively in fire control work in the northwestern States. A brief account is given of experience, methods of training and the equipment used.

43.13 : 07.7. **Standard portable forest fire pump (motor driven) and equipment.** Canadian Society of Forest Engineers, Fredericton, N.B. Revised to March, 1943. pp. 51.

43.3. *Fire Damage*

43.3 (67.5). QUARRÉ, P. **Contribution to study of problem of bush fires for Haut Katanga.** *E. Afr. agric. J.* 9, 1943 (118–20).

A brief summary of observations on the question of annual bush fires in relation to various aspects of land use in the savannas of the Haut Katanga, Belgian Congo.

44. DAMAGE BY HARMFUL PLANTS. VIRUS DISEASES

44.3. *Fungi*

44.3 (73) : 07.7. TILFORD, P. E. **War-time formulas—fungicides.** With discussion. *Proc. 18th nat. Shade Tree Conf.* 1942 (68–78). [Ohio Agricultural Exp. Sta., Wooster, Ohio.]

A discussion on the present position in the United States with regard to fungicides of the type used primarily on trees; the most important of which contain either sulphur or copper as the fungicidal agent. Sulphur is particularly effective against rusts and mildews. It is extensively used in the form of lime-sulphur, but wettable sulphurs (e.g. flotation sulphur) are less likely to cause foliage injury. No shortage of sulphur is expected, and there is no need for the conservation of this fungicide.

Copper, on the other hand, is definitely in short supply. It is used as a fungicide primarily in the form of bordeaux mixture, but 'fixed coppers' (e.g. basic copper chloride, basic copper sulphates, copper oxides, copper hydrate) are generally safer although not quite so effective in disease control. It is recommended that, wherever possible, copper should be conserved and replaced by sulphur for fungicidal use.

44.3 : 12.21 : 12.19. SMOTLACHA, F. Symbiosa velkých hub s lesními stromy. [**Symbiosis of macromycetes and forest trees.**] *Lesnická Práce* 21 (4/5), 1942 (208–11). Biol. Abstr. 17 (23146).

Earlier investigations showed that most of the macromycètes, especially the Hymenomycetes, live in symbiosis with forest trees. Many of them live with only one or a few genera of trees, others with almost any genus. Some also are associated with grasses or shrubs, but trees are the main symbionts.

44.3 (43.6) : 12.21. LOHWAG, H. Zum Sterben der Bäume im Lainzer Tiergarten (Wien). [**On the death of trees in the Lainzer Tiergarten (Vienna).**] *Cbl. gesamte Forstw.* 68, 1942 (179–97). [G.]

Notes on damage to different tree species by various *Polyporaceae.*

44.3 (68.9) : 92 : 12.21. SOUTHERN RHODESIA. *Government Notices* 184–7, 1943. pp. 7. R.A.M. 22, 1943 (416).

Under the terms of the Plant Import Regulations, 1943, made under the Plant Protection Act, 1942, the following restrictions apply, as from 9th April, 1943, to the introduction of Elm (*Ulmus*) and Chestnut (*Castanea*) from non-scheduled States (i.e. all countries except the Union of South Africa, Northern Rhodesia, the Belgian Congo, and Nyasaland Protectorate). The

importation is prohibited of Elm seeds and plants (including all species of *Ulmus*) from the continent of Europe or from any country known to harbour the disease *Ceratostomella ulmi*, and of Chestnut (*Castanea*) seeds and plants from North America or any other known habitat of *Endothia parasitica*.

44.3 : 12.25 : 42.21. BURGER, H. Frostschaden und Lärchensterben. **[Frost damage and the death of Larches.]** *Schweiz. Z. Forstw.* 94, 1943 (52–8). [G.]

Notes are included from records of the Adlisberg experimental nursery, from which it appears that the Alpine Larch stands that suffered heavily from canker in 1922–24 had previously been weakened over a period of several years by needle pests and diseases. This is thought to have been an important predisposing factor, probably being effective by lowering the frost resistance of the trees.

44.3 (83) : 12.25 : 12.21. Principales enfermedades parasitarias que fueron objets de consulta en el primer semestre de 1942. **[The principal parasitic diseases which were the object of consultation during the first half of 1942.]** *Bol. Sanid. veg., Santiago* 2 (1–2), 1942 ([60–9]). [Span.] R.A.M. 22, 1943 (470).

Among the plant diseases investigated during the first half of 1942 by the phytopathologists attached to the Chilean Ministry of Agriculture was *Sphaeropsis pinastri* (*Diplodia pinea*) on *Abies pinsapo*.

44.3 : 12.25 : 12.21 : 92 (73). FULLING, E. H. **Plant life and the law of man. IV. Barberry, currant and gooseberry, and Cedar control.** *Bot. Rev.* 9, 1943 (483–592).

An account is given of the history of legislation and litigation in the United States with respect to the eradication and quarantine of the alternate hosts of the heteroecious fungi responsible for the black stem-rust of wheat, the blister rust of White Pine caused by the fungus *Cronartium ribicola*, and the Apple (or Cedar) rust caused by the fungi *Gymnosporangium juniperi-virginianae*, *G. globosum* and *G. germinale*.

It is pointed out that the plants whose destruction is frequently demanded have in themselves real value, and that Cedars, currants, gooseberries, and even barberries, are *per se* no more a nuisance than the alternate economically important hosts of the respective fungi for whose benefit they are to be eradicated. In dealing with cases of host destruction, therefore, consideration should be given to the relative value of the property in question, and the owner of destroyed property should receive due compensation.

Chronologically arranged summaries of colonial, federal, state and departmental legislation and regulations are given with regard to the eradication of (1) barberry, (2) currants and gooseberries, and (3) Red Cedar, and relevant bibliographies (amounting to 18 pages) are included.

44.3 : 12.25 : 12.21. SLAGG, C. M., and WRIGHT, E. **Control of Cedar blight in seedbeds.** *Amer. Nurserym.* 78 (7), 1943 (22–5).

All species of *Juniperus* are susceptible to attack by the Cedar blight fungus (*Phomopsis juniperovora*), but the disease is usually most severe on Eastern Red Cedar (*J. virginiana*), especially in the seedbed stage. Experiments carried out during an epidemic of the blight in 1941 revealed that under Kansas conditions thinly-sown seedbeds are more severely attacked than thickly-sown beds; and in a preliminary experiment it was observed that considerably less disease occurred in a section of a seedbed watered by ditch irrigation than in an adjacent section watered by an overhead sprinkler.

All the standard fungicides tested reduced the amount of infection, but Special Semesan gave the greatest degree of control. Lime-sulphur, wettable sulphur, and arsenic compounds all produced more or less serious burning of foliage, while the soils of plots treated with bordeaux mixture became strongly alkaline.

It is believed that weekly spraying between June 1 and October 1 will furnish adequate protection to young seedlings. Sanitary measures, in particular the removal of blighted seedlings, will increase control. A combination of roguing and spraying reduced seedling loss from blight to 1·44 per cent. with bordeaux mixture, 1·63 per cent. with Cuprocide, and 0·55 per cent. with Special Semesan.

44.3 (77.5) : 12.25 : 12.21. ROTH, L. F., and RIKER, A. J. **Life history and distribution of *Pythium* and *Rhizoctonia* in relation to damping-off of Red Pine seedlings.** *J. agric. Res.* 67, 1943 (129–48). [Wisconsin Agricultural Exp. Sta.] O.R.E.

44.3 : 12.25 : 12.21. ROTH, L. F., and RIKER, A. J. **Influence of temperature, moisture, and soil reaction on the damping-off of Red Pine seedlings by *Pythium* and *Rhizoctonia*.** *J. agric. Res.* 67, 1943 (273–93). [Wisconsin Agricultural Exp. Sta.] O.R.E.

44.3 : 12.25 : 12.21. ROTH, L. F., and RIKER, A. J. **Seasonal development in the nursery of damping-off of Red Pine seedlings caused by *Pythium* and *Rhizoctonia*.** *J. agric. Res.* 67, 1943 (417–31). [Wisconsin Agricultural Exp. Sta.] O.R.E.

These three papers deal with two important damping-off fungi, *Pythium irregulare* and *Rhizoctonia solani*. The first paper is concerned chiefly with the identification of the two fungi, the symptoms they induce, their life histories in relation to pathogensis, and their distribution. The second and third papers give the results of studies on the influence on the fungi of certain environmental factors.

Both fungi are responsible for serious damping-off among seedlings of Red Pine (*Pinus resinosa*) in forest nurseries in Wisconsin. The symptoms which they induce in the host vary according as they are associated with other organisms and appear to be correlated with their respective growth habits.

Temperature had a marked effect on the virulence of both fungi. At 33° C. about half of the seedlings were killed by *Pythium*, while at 12° C. more than 90 per cent. were killed. Only a few seedlings were killed by *Rhizoctonia* at 12°, but losses increased to a maximum of 58 per cent. at 24–30° and decreased again at 33°.

Damping-off by *Pythium* increased with the moisture content of the soil from a minimum at 13 per cent. to a maximum at 100 per cent., while that caused by *Rhizoctonia* gradually increased from a high level at 13 per cent. to a maximum at 68 per cent., and then decreased to a minimum at saturation.

Air humidity has little or no effect on the amount of damping-off by *Pythium*, although losses caused by aerial mycelia of *Rhizoctonia* increased with high air humidity.

Acidity was found to be an important factor affecting the growth of both the fungal mycelia and the Pine seedlings. Conditions most favourable to damping-off by *Pythium* were between pH 5·2 and 8·5. This range was only moderately favourable for *Rhizoctonia*, but

mycelia development of that fungus was rapid with acidity stronger than pH 5·2. Increase in damping-off by both fungi at levels above pH 7 appeared to be associated with decline in host development.

The highest percentage of damping-off occurred in Red Pine seedlings about 11–13 days old. After about a month the seedlings became comparatively resistant to the disease.

44.3 : 12.25 : 12.21. WATERMAN, A. M. ***Diplodia pinea*, the cause of a disease of hard Pines.** *Phytopathology* 33, 1943 (1018–31).

This paper deals with the taxonomy of *Diplodia pinea* (Desm.) Kickx (*Sphaeropsis ellisii* Sacc.), its hosts and distribution, and the pathological effects of the fungus in the natural and artificial infection of hard Pines. *D. pinea* is widely distributed in the United States and has also been reported in various countries lying between the latitudes 30 and 50 degrees north and south of the equator in both hemispheres. In the United States the exotic Pines, *Pinus nigra*, *P. sylvestris*, and *P. mugo* var. *mughus* are most commonly attacked, but the fungus also occurs occasionally on 8 other species of hard Pine. Although no extensive injury has been caused by *D. pinea* in forest plantations, its presence may be of considerable importance to ornamental trees which it weakens by killing back the growth of successive seasons.

Inoculation tests indicate that, while the fungus is capable of infecting healthy, actively-growing buds and leaves, infection will take place more readily through wounds.

44.3 : 12.25 : 12.21. WATERMAN, A. M. ***Diplodia pinea* and *Sphaeropsis malorum* on soft Pines.** *Phytopathology* 33, 1943 (828–31). [U.S. Bureau of Plant Industry.]

The results of observations and inoculations indicate that neither *Diplodia pinea* nor *Sphaeropsis malorum* is parasitic upon the leaves and twigs of the new growth on vigorously growing White Pines. Both fungi, however, occasionally may be contributing factors in the unhealthy condition of soft Pines that have been weakened primarily by other agencies. *From author's summary.*

44.3 : 12.25 : 12.21 : 12.11.3 : 12.11.22. RIKER, A. J., KOUBA, T. F., BRENER, W. H., and BYAM, L. E. **White Pine selections tested for resistance to blister rust.** *J. For.* 41, 1943 (753–60). [Wisconsin Agricultural Exp. Sta.]

For the purpose of studying the resistance of native Wisconsin White Pine (*Pinus strobus*) to the blister rust (caused by *Cronartium ribicola*), selections were made of young cone-bearing trees that showed no blister rust cankers after years of close association with *Ribes* bushes. From these trees open-pollinated seed was collected, as well as twigs, which were grafted on ordinary White Pine 2 + 2 transplants.

An experimental nursery was prepared for testing the resistance to blister rust of the selected trees and their seedling progeny. Included in the tests were 1,000 grafts and 10,000 seedlings of selected stock, some seedlings of commercial stock, as well as 600 *Ribes* bushes (*R. missouriense*, *R. cynosbati* and *R. nigrum*), so placed that each Pine tree was 3–8 ft. from a *Ribes* bush. Two replicate plantings received natural inoculation only, while two others had natural inoculation supplemented with artificial inoculation.

Results showed that after both natural and artificial inoculation a high percentage of seedlings had stem cankers within a year (56 and 64 per cent. from *Ribes cynosbati* and 85 and 91 per cent. from *R. nigrum*), whereas only a small percentage of grafts showed stem cankers (5 per cent. from *R. cynosbati* and 4 per cent. from *R. nigrum*).

Experience in the vegetative propagation of White Pine, both by grafting and by rooted cuttings, indicates its possible value and the need for improvement in selection of material and the making and treating of cuttings.

44.3 : 12.25 : 12.21. BEDWELL, J. L., and CHILDS, T. W. **Susceptibility of Whitebark Pine to blister rust in the Pacific Northwest.** *J. For.* 41, 1943 (904–12). [U.S. Forest Pathology Field Laboratory, Portland, Oregon.]

Studies of nursery material and of larger trees in natural stands in British Columbia and the northwestern states have shown that Whitebark Pine (*Pinus albicaulis*) is much more susceptible to blister rust (*Cronartium ribicola*) than is Western White Pine (*P. monticola*), and is subject to serious infection at distances from *Ribes* greater than those over which the rust can usually spread to Pines.

44.3 (45) : 12.25 : 12.21. **Italy: phytopathological observations.** *Int. Bull. Pl. Prot.* 17 (5), 1943 (69M–70M) R.A.M. 22, 1943 (467–8).

It is recorded that *Cronartium asclepiadeum* caused severe damage to Austrian Pine (*Pinus nigra*) in the Massa region of Tuscany.

44.3 : 12.25 : 12.21. BINGHAM, R. T., and EHRLICH, J. **A *Dasyscypha* following *Cronartium ribicola* on *Pinus monticola*.** *Mycologia* 35, 1943 (95–111, 294–311). R.A.M. 22, 1943 (412–3).

Amended descriptions are given of *Dasyscypha calyciformis* and *D. agassizii*. A small-spored, white-excipled species of the same genus frequently associated with blister rust (*Cronartium ribicola*) cankers on *Pinus monticola* in the north-western United States, is stated often to have been confused in the past with the above-mentioned two species. A comparative study of the three fungi showed, however, that it can be distinguished from them by several characters which are indicated. It is concluded that the fungus on *P. monticola* is distinct from the two other species, but as it was not possible to compare large numbers of the three fungi from various hosts it is not proposed as a new species.

44.3 : 12.25 : 12.21. LIHNELL, D. *Tetramyxa rhizophaga* Lihnell n. sp., ein Parasit in den Wurzeln von *Juniperus communis* L. [***Tetramyxa rhizophaga* Lihnell n. sp., a parasite in the roots of *Juniperus communis* L.**] *Symb. bot. upsaliens.* 5 (4), 1942, pp. 11 + plate. [G.] R.A.M. 23 (48).

In two parts of Sweden the author detected a hitherto unknown representative of the Plasmadiophoraceae occurring as a parasite in Juniper roots, and assigned to it the name of *Tetramyxa rhizophaga* n. sp., descriptive of the tetrahedral spore tetrads. The fungus, which is characterized by spheroid or broadly ellipsoid, continuous, subhyaline to light brown spores, 4 to 6 μ in diameter, differs from most of the other plasmadiophoraceae in its failure to induce hypertrophy of the affected organs. The cytology of the new species is fully described.

44.3 : 12.25 : 12.21. MATTSSON-MÅRN, L., and NENZELL, G. Studier över snöskytteangrepp inom tallföryngringar å Bergvik & Ala Nya Aktiebolags. **[Studies on *Phacidium* blight in Pine nurseries belonging to Bervik and Ala Nya Ltd.]** *Norrlands SkogsvFörb Tidskr.* 1941 (160–91). [Sw.g.] S.P.S.

The extent of the attack of *Phacidium infestans* in nurseries depends largely on the depth of snow, 4–6 dm. appearing to be the limit under which infection can spread. The fungus is spread by mycelia during April and May and mature spores are discharged in the autumn.

44.3 (54) : 12.25–8 : 12.21. CUMMINS, G. B. **Uredinales from the northwest Himalaya.** *Mycologia* 35 (4), 1943 (446–58). R.A.M. 23 (43).

New records for India include *Melampsora laricipitea* on *Salix hastata* and *S. oxycarpa*, and *Gymnosporangium confusum* on *Crataegus oxyacantha*, *Pyrus lanata*, and *Juniperus macropoda*. Some uncertainty exists as to the telial collection of this species, for although the galls, teleuto scars, and teleutospores agree fairly well with *G. confusum*, the host on which it was found, *J. macropoda*, grew next to *Cotoneaster nummularia* from which *G. clavariaeforme* was collected, and such close association is considered to be highly suggestive, though not conclusive.

44.3 : 12.25–8 : 12.21. TEXAS. **Texas Agricultural Experiment Station. Fifty-fourth annual report, 1941.** Agricultural and Mechanical College of Texas, College Station, Texas. [1942?] pp. 202.

Greenhouse inoculation tests have shown that seedlings of *Albizzia lophantha*, *A. kalkora* and *A. lebbek* are susceptible to attack by the root-rot fungus *Phymatotrichum omnivorum*, while *A. julibrissin* gave negative results. In field tests 50 per cent. of seedlings of Russian Olive and Chinese Elm were killed by the fungus, while seedlings of Red Cedar (6) and Mimosa (3) survived 100 per cent. and those of Slash Pine showed a mortality of one in eight (p. 65).

44.3 : 12.26–8 : 12.21. GÄUMANN, E. Über die Entwicklung und die Wirtswahl einiger schweizerischer Rostpilze. **[On the development and choice of host of some Swiss rust fungi.]** *Ber. schweiz. bot. Ges.* 53A, 1943 (465–79). [G.] R.A.M. 22, 1943 (408–9).

Three new species of *Puccinia* are described and some additional information concerning *Melampsora laricipitea* is presented in this paper. Teleutospores of *M. larici-epitea* f. sp. *larici-retusae* on *Salix retusa* were transferred the following spring to Larch, and the resultant uredospores were used for cross-inoculations on 15 *Salix* species, of which 9 proved to be more or less susceptible, one (*S. reticulata*) slightly so, and the remaining five (*S. alba*, *S. caesia*, *S. caprea*, *S. purpurea*, and *S. repens*) immune.

44.3 : 12.26–8 : 12.21 : 12.11.3. HUNTER, A. W. S., and DAVIS, M. B. **Breeding rust resistant black currants.** *Proc. Amer. Soc. hort. Sci.* 42, 1943 (467–8). [Central Experimental Farm, Ottawa, Ontario.] E.M.B.

A search was begun in 1935 for varieties of black currants resistant to the White Pine blister rust (*Cronartium ribicola*). One bush of *Ribes ussuriense* Jancz. proved either immune or highly resistant to the disease, while several plants of the Colorado currant (tentatively identified as *R. aureum* Pursh. and *R. odoratum* Wendl.) showed some degree of resistance. *R. ussuriense* is a plant of vigorous habit, but the fruit is small and unpalatable. Crosses were made in 1938 and 1939 between the three above-mentioned species and the standard varieties of Boskoop Giant and Kerry, both of which are derived from *Ribes nigrum*. In the 45 crosses between *R. ussuriense* and Boskoop Giant, and the 168 crosses between *R. ussuriense* and Kerry no case of blister rust infection was recorded. Out of 130 Kerry × *Ribes ussuriense* plants, 5 seedlings were infected. Crosses between the two less resistant species (*R. aureum* and *R. odoratum*) and the standard varieties gave less satisfactory results. All the seedlings which have fruited to date show a marked resemblance in fruit characteristics to their cultivated parent. Most of them are, however, susceptible to powdery mildew.

44.3 (73) : 12.26–8 : 12.21. LOHMAN, M. L., and WATSON, A. J. **Identity and host relations of *Nectria* species associated with diseases of hardwoods in the United States.** *Lloydia* 6 (2), 1943 (77–108). R.A.M. 23 (47–8).

The object of this paper is to present the morphological and cultural aspects of the species of *Nectria* designated by Spaulding and others Nos. 1 and 2, and now identified as *N. coccinea* on the bark of *Acer saccharophorum* in New England; *N. coccinea* var. *faginata* n. var., isolated from the weak and mostly scale-infested cortex of Beech (*Fagus grandifolia*) in New England and the Canadian Maritime Provinces; *N. galligena* from the bark, callus tissue and recently exposed sapwood of various hosts, including *Acer* spp., Birch (*Betula* spp.), Beech, Ash (*Fraxinus nigra*), *Carya* spp., Walnut, Poplar (*Populus grandidentata*), Aspen, *Prunus serotina*, Oak, Lime (*Tilia americana*), and Elm (*Ulmus americana*), throughout the eastern States, usually in association with cankers and on bud-scale scars; *N. magnoliae* n. sp. from the same portions, generally cankered, of *Liriodendron tulipifera*, *Magnolia fraseri*, *M. tripetala*, from Connecticut to Ohio and southwards through the Appalachian forests; and three somewhat aberrant forms of *N. mammoidea* from dead Birch in Vermont and dead and living Oaks in Maryland and Georgia, respectively.

An outline of the gross cultural characters of these species of *Nectria* on three standard culture media (synthetic malt and potato dextrose agar and steamed rice) is appended for use either in the provisional determination of cultures or specimens, or for the critical identification of the latter when considered in conjunction with the size and shape of ascospores and conidia.

44.3 : 12.26–8 : 12.21. STUNTZ, D. E., and SELISKAR, E. C. **A stem canker of Dogwood and Madrona.** *Mycologia* 35 (2), 1943 (207–21). R.A.M. 22, 1943 (458–9).

During the past few years *Cornus nuttallii* and *Arbutus menziesii* trees in Seattle and the vicinity have become increasingly affected by cankers which girdle the stem and eventually kill the tree. When tissues from cankers on both tree species were incubated, two organisms were obtained:—a *Phomopsis*, later found to be a secondary parasite, and a species of *Phytophthora*, identified as *P. cactorum*. This is the first record of *P. cactorum* on these hosts.

The fungus was found by inoculation tests to be quite virulent on *Acer macrophyllum*, and able to attack *Pseudotsuga taxifolia*, *Alnus rubra*, *Salix scouleriana*, and *Corylus californica*.

44.3 : 12.26–8 : 12.21. DAVIDSON, R. W., and CAMPBELL, W. A. **Decay in merchantable Black Cherry on the Allegheny National Forest.** *Phytopathology* 33, 1943 (965–85). [Allegheny Forest Exp. Sta.]

A study was made of the decay caused by various fungi in 3 merchantable stands of *Prunus serotina* (aged 52 years, 116 years, and 120 years respectively) in the Allegheny National Forest. The numerous infections which were present mostly in the butt of the younger trees caused only 2·3 per cent. cull based on board-foot volume. In the older stands top or trunk infections were more important, and there was 6·1 per cent. cull from decay in open-grown trees and 11·3 per cent. cull in trees from a pure dense stand. The most important butt rots were caused by *Polyporus sprague*i, *P. berkeleyi*, and *Coniophora cerebella*, while the fungi chiefly responsible for trunk rots were *Poria prunicola*, *P. mutans*, *Fomes pinicola*, and *Polyporus sulphureus*. The species most frequently isolated from Black Cherry was *Poria prunicola*.

The results indicate that, from the standpoint of decay, *Prunus serotina* should be a good tree to manage for lumber production as the few fungi which attack the heartwood of this species do not have time to cause excessive cull before merchantable size is attained.

A key is included for the recognition of Black Cherry decay fungi grown on malt agar.

44.3 : 12.26–8 : 12.21. ZOGG, H. Untersuchungen über die Gattung *Hysterographium* Corda, insbesondere über *Hysterographium fraxini* (Pers.) de Not. [**Studies on the genus *Hysterographium* Corda, particularly on *Hysterographium fraxini* (Pers.) de Not.**] *Phytopath. Z.* 14 (4), 1943 (310–84). [G.] R.A.M. 22, 1943 (504).

This comprehensive paper gives the results of biological, pathological, and cytological studies at the Federal Technical College, Zürich, on *Hysterographium fraxini*, together with facts about the taxonomy of the genus *Hysterographium* and of the Hysteriales in general.

H. fraxini is a non-specialized, facultative saprophyte, which may be responsible for extensive damage to Ash (*Fraxinus excelsior* and *F. ornus*) in Switzerland under conditions adverse to the host, e.g. humid, sheltered situations, or water-logged soils. The fungus enters branches of any age through fresh wounds in the spring-time and at first develops saprophytically, but later it encroaches on the surrounding living tissue. Towards the end of the summer the leaves above the site of infection begin to wither, since by this time the branch is almost completely girdled. In vigorous trees the formation of callus between the upper and lower parts of the branch arrests further growth, which in any case ceases in the late autumn at a temperature of 3° C. Re-infection can occur only through a fresh injury in healthy trees, but in trees which are seriously weakened and where no callus is formed the fungus may pass from the already invaded branches to sound ones and finally to the trunk.

44.3 : 12.26–8 : 12.21 : 42.21 : 21.63.1. LEIBUNDGUT, H., and FRICK, L. Eine Buchenkrankheit im schweizerischen Mittelland. [**A disease of Beech in the Swiss midlands.**] *Schweiz. Z. Forstw.* 94, 1943 (297–306 + plates). [G.]

In various localities *Nectria coccinea* attacked trees damaged by the severe frost of the winter of 1939–40. The disease was observed chiefly on 60- to 120-year-old dominant and co-dominant trees.

44.3 : 12.26–8 : 12.21 LOHWAG, K. Der Buchenschwamm im Prater. [**Beech fungus in the Prater.**] *Cbl. gesamte Forstw.* 69, 1943 (54–8). [G.] [Hochschule für Bodenkultur, Wien.]

Notes on damage by *Ungulina fomentaria*, chiefly to Horse Chestnut trees.

44.3 : 12.26–8 : 12.21. GRODSINSKY, L., and JENKINS, A. E. '*Sphaceloma murrayae*' en diversas especies de '*Salix*'. [***Sphaceloma murrayae* on various species of *Salix*.**] *Rev. Argentina Agron.* 10 (1), 1943 (55–8). [Span.] Biol. Abstr. 17 (24586).

Examination of herbarium material of *Salix* in different herbaria of the U.S., and a collection made in Argentina, shows that *Sphaceloma murrayae* occurs on *Salix fragilis*, *S. f.* × *alba*, *S. lasiolepis*, *S. l.* var. *sandbergii*, and *S. viminalis*. *S. babylonica*, as mentioned elsewhere, is also a host of the *Sphaceloma*. The geographic distribution of this fungus, extended by the herbarium material, is given.

44.3 : 12.26–8 : 12.21. CRANDALL, B. S. **Spread of Persimmon wilt.** *Plant Dis. Reptr.* 27 (7/8), 1943 (158–60 + map). R.A.M. 22, 1943 (489).

The results of a limited survey in North Carolina from 1940 to 1942 and along some 500 miles of highway in Florida and South Carolina in 1942 indicate that the wilt disease (*Cephalosporium* sp.) of Persimmon (*Diospyros virginiana*) has spread into new territory in the Carolinas. Within its known range it has increased in regions where the host is abundant and decreased where it is scarce.

44.3 : 12.26–8 : 12.21. HEPTING, G. H., and TOOLE, E. R. **Mimosa wilt—a major problem.** *Proc. 5th Sth. Shade Tree Conf.* 1942 (254–8). [U.S. Bureau of Plant Industry.]

Although there are many plants susceptible to wilt diseases caused by various species of *Fusarium*, Mimosa wilt is the first recorded case of a *Fusarium* wilt of a tree. The causal fungus is probably a recently introduced species. An epidemic form of wilt disease of Mimosa, similar in all respects to the American disease, was reported from southern Russia in 1920.

Inoculation experiments with other leguminous trees showed that Black Locust (*Robinia pseudoacacia*), Honey Locust (*Gleditsia triacanthos*), Catalpa (*Catalpa speciosa*), Redbud (*Cercis canadensis*) and the exotic *Albizzia thorelii* are probably immune, while *Albizzia lebbek*, *A. lophantha* and *A. kalkora* (especially the two latter) are decidedly susceptible. Natural infection appears to take place entirely through the soil. Since the fungus is capable of living and growing for months in sterilized soil, measures for controlling the disease are very difficult. An attempt made in North Carolina to eradicate Mimosa wilt by cutting and burning all diseased trees had no noticeable effect in preventing the spread of the disease. Treatment by injection has not been tried owing to the limited funds available for experimentation, but attempts are being made to breed naturally resistant trees.

44.3 : 12.26–8 . 12.21 : 23.21. MILLER, P. A. **Powdery mildew of the Coast Live Oak.** *Proc. 9th West. Shade Tree Conf.* 1942 (358–66). [Univ. of California at Los Angeles.]

Of those species of Oak known to be susceptible to the powdery mildew disease caused by *Sphaerotheca lanestris* Hark., only one, the California Live Oak (*Quercus agrifolia*), has been observed to develop a

'witches' broom'. It has been found that individual trees of this species differ considerably in their resistance to infection, but the selection and propagation of mildew-resistant trees is a matter of some difficulty, as seedlings grown from seed of apparently immune trees show no degree of uniformity in mildew resistance, and attempts to root cuttings of trees having the desired qualities have so far met with no success. Results of various measures to control the disease by pruning and spraying are reported and discussed. The Holm or Holly Oak (*Quercus ilex*) is apparently immune to infection by *Sphaerotheca lanestris*, and it is suggested that this species, which seems well adapted to the coastal section of California where the disease is prevalent, should be used more extensively in landscape plantings.

44.3 : 12.26–8 : 12.21. GRANDALL, B. S. ***Thyronectria* disease of Honey Locust in the south.** *Plant Dis. Reptr.* 26 (17), 1942 (376). R.A.M. 22, 1943 (505).

Gleditsia triacanthos throughout middle and western Tennessee and the northern half of Mississippi and Alabama is affected by the canker disease due to *Thyronectria austro-americana*. The cankers may be as small as a pin's head or reach ½ in. in diameter. Eventually they enlarge or coalesce and girdle the branch. The fungus also penetrates the vascular system, producing reddish-brown streaking of the outer wood for several inches in each direction from the visible canker. A gummy exudate is present on many cankers. In Tennessee some trees succumb to the disease, but in many areas healthy trees are found near dying ones for a number of consecutive seasons; apparently, considerable natural resistance to infection exists.

44.3 : 12.26–8 : 12.21. BENDER, T. R. ***Fusarium* die-back of American Holly.** *Nursery Dis. Notes N.J. agric. Exp. Sta.* 13, 1941 (45–8); 14, 1941 (1–4).

In recent years trees of American Holly (*Ilex opaca*) in New Jersey have been attacked by a hitherto undescribed fungous disease caused by a species of *Fusarium*, tentatively identified as *F. solani* var. *martii*. Although the disease is seldom fatal, it causes considerable disfigurement of infected trees (through die-back of twigs and branches) if preventive measures are not applied. The main external and internal symptoms of the disease are described in this paper.

Tests of the pathogenicity of the fungus showed that infection may take place through very young leaves, through wounds in both young and old stems, and possibly through the terminal portions of unwounded stems of the current year's growth. There is also reason to believe that the fungus is capable of entering the plant through the blossoms.

The most important control measures at present in use are the complete removal and burning of all fallen leaves and infected branches, and the antiseptic treatment of pruning cuts and other mechanical injuries before dressing. The value of fungicidal sprays cannot be definitely established until further data are available.

44.3 : 12.26–8 : 12.21. PIRONE, P. P. **New observations on bleeding canker of hardwoods.** *Nursery Dis. Notes N.J. agric. Exp. Sta.* 13, 1941 (37–44).

Very little detailed information is at present available on the bleeding canker disease of hardwoods known to be caused by the fungus *Phytophthora cactorum*. Observations made by the author have, however, made clear the following points:—(1) Every tree with bark cankers from which a pink ooze exudes is not necessarily infected by *P. cactorum*. This conditions may also develop as a result of insect injuries or mechanical wounds. (2) Every tree infected by *P. cactorum* does not succumb within a short period. At least partial recovery has been observed to occur without the use of special treatments. (3) All trees infected with *P. cactorum* do not exhibit pink ooze in the vicinity of bark lesions. In many cases artificially inoculated trees had not shown this symptom within a year after infection began. (4) There is as yet no clear-cut evidence that diseased trees actually recover following any specialized injection treatment. Failure to re-isolate the fungus from treated trees is not in itself a proof of the destruction of the pathogen by the injected chemical. The fungus may have died as a result of high temperatures, lack of moisture or other unfavourable environmental factor within the host.

The application of fertilizers to infected trees increases the severity of the disease. A great deal of research is still necessary in order to obtain information on such points as the mode of entrance of the fungus into the host, the way the disease is spread, and the influence of environmental factors on both host and pathogen.

44.3 : 12.26–8 : 12.21 : 01.4. DODGE, A. W. **Practical aspects of tree injection for disease control.** With discussion. *Proc. 18th nat. Shade Tree Conf.* 1942 (154–63). [F. A. Barlett Tree Expert Co., Cambridge, Mass.]

After an exhaustive study of bleeding canker disease in hardwoods and of the treatment of this disease by the injection of various di-amino-azo-benzene compounds into the vascular systems of diseased trees, commercial treatment of trees infected by the causal fungus, *Phytophthora cactorum*, was begun in 1940 and has been continued in the following years. The translating of laboratory practice to field operations presented some difficulties, but standardized equipment and procedure have now been evolved. The number of failures during the first season was approximately 12 per cent. of the total number of trees injected. These failures were probably due in part to lack of technical knowledge and skill on the part of workers, and to attempts to cure trees that were already beyond recovery. During 1941 the percentage of failures, based upon the absence of *P. cactorum* in the treated tree, was less than 8 per cent.

A limited amount of experimental work was also done in the field to ascertain the commercial possibilities of treating other vascular diseases by injection, but war conditions have interfered with the continuance of this work.

Data are included on the actual technique of tree injection which was developed in the course of the experimental work on bleeding canker disease.

44.3 : 12.26–8 : 12.21. MILLER, P. A. ***Phytophthora* crown and root rot.** *Proc. 9th West. Shade Tree Conf.* 1942 (320–5). [Univ. of California, Los Angeles.]

Species of *Phytophthora* are known to cause a watery brownish decay of bark tissue at the root crown of various Californian trees and shrubs, some of which are named in this paper. The more characteristic symptoms of the disease are the discoloured spots or areas of the bark of roots, the root crown, or the main trunk and lateral branches some distance above the ground. These lesions or cankers can be located by

lightly scraping the bark surface. Exudation of gum or fluid at the margins of diseased areas is frequently associated with *Phytophthora* infections, but, like the declining vigour of the plant and the dieback of terminal branches, this cannot be used as a diagnostic symptom as it may result from various other causes. The conditions which chiefly favour infection are:— (1) maintenance of excessively wet soil in the root zone and at the root crown due to prolonged heavy rains, over-irrigation or lack of surface and subsurface drainage; (2) deep planting in heavy, water-retentive soils; (3) burial of the root crowns and basal portions of the stems or trunks with soil of this character or debris by grading or by erosion; (4) application of large amounts of moisture-retentive organic materials such as straw, manure and leaf mould to the soil, especially at the base of the tree and in contact with the trunk; (5) injuries to roots and root crown. Means of prevention and control are indicated.

44.3 (74.9) : 12.26–8 : 12.21. PIRONE, P. P. **Latest recommendations on control of canker stain of London Plane.** *Nursery Dis. Notes N.J. agric. Exp. Sta.* 15, 1942 (21–4).

Research by Dr. J. M. Walter on the highly destructive disease of London Plane (*Platanus acerifolia*) caused by a fungus of the genus *Endoconidiophora* has revealed that the spread of this disease in New Jersey may be brought about by the use of infected pruning tools or of wound dressings which contain sawdust from infected wood. Dr. Walter found also that practically no infections took place when Planes were pruned during the months of December and January. The author of this paper suggests that the promulgation of local ordinances confining the pruning of Planes to the two aforementioned months in areas of high disease incidence would help greatly in preventing further dissemination of the fungus in New Jersey.

44.3 (74.9) : 12.26–8 : 12.21. REX, E. G. **Dutch Elm disease in New Jersey.** With editor's comment. *Shade Tree* 16 (3–6), 1943. pp. [8].

An outline is given of the Dutch Elm disease control work carried on in the state of New Jersey from 1935 to 1943. Until recently a large amount of sanitation and eradication work was included in the control programme. Evidence was obtained of the part played by the smaller bark beetle, *Scolytus multistriatus*, in the spread of the disease, and field studies have indicated that the presence of cut Elm wood suitable for the breeding of bark beetles constitutes a serious menace to neighbouring healthy trees. A wood pile survey has been carried out by the New Jersey Department of Agriculture in a number of New Jersey towns where the disease was of significant importance, and a study is being made of the spread of the disease in three areas. It is believed that the disposal of Elm wood suitable for the breeding of the smaller bark beetle will, in the absence of other measures, temporarily control the disease within reasonable limits. In the appended comment by the editor, stress is laid on the possibility of controlling the spread of Dutch Elm disease by the removal of devitalized trees, sanitation trimmings, and the avoidance of piles of cut wood providing breeding grounds for the smaller bark beetle. If the disease is detected in time it is believed that infected trees may be saved by the removal of the diseased portion.

44.3 (75.9 : 76.2–3) : 12.26–8 : 12.21. LARGE, J. R. **Recent observations on threadblight, *Corticium stevensii*, of Tung and some native plants in the southeastern United States.** *Plant Dis. Reptr.* 27 (10/11), 1943 (223–4). R.A.M. 22, 1943 (459).

Thread blight due to *Corticium stevensii* is one of the most serious diseases of Tung (*Aleurites* spp.) trees in the United States. Most of the infected orchards are near swamps, and in two swamps in Louisiana *Liquidambar styraciflua*, *Nyssa sylvatica*, *Cornus florida*, *Malus angustifolia*, *Rubus* sp., *Aquilegia canadensis*, *Ilex opaca*, and *I. glabra* were found infected.

Methods of control are discussed.

44.3 (79.6) : 12.25–8 : 12.21. EHRLICH, J. **Recently active leaf diseases of woody plants in Idaho.** *Plant Dis. Reptr.* 26 (18), 1942 (391–3). R.A.M. 22, 1943 (503).

In these notes on leaf diseases of woody plants in Idaho during 1941–2 the author states that every specimen of Larch (*Larix occidentalis*) leaf examined microscopically showed the fruiting structures of *Meria laricis*. This fungus does not appear to have been recognized before in North America, but there can be no doubt that it is firmly established in the Pacific Northwest. Necrosis of the needles of Lodgepole Pine (*Pinus contorta* var. *latifolia*) was commonly associated with an apparently undescribed species of *Hendersonia*. *Chloroscypha seaveri* was repeatedly found associated with the death of *Thuja plicata* twigs. *Fusicladium radiosum* (= *Napicladium tremulae*, conidial stage of *Didymosphaeria populina*) was aggressive in the leaves and twigs of Golden Aspen (*Populus tremuloides* var. *aurea*). The uredo- and teleuto-stages of *Melampsora albertensis* developed so intensely on the same host that the foliage had turned yellow and dried by midsummer. Leaf spot (*Septoria alnifolia*) was abundantly present on Sitka Alder (*Alnus sinuata*) in the summer of 1942, though apparently not recorded before in Idaho.

44.3 (81) : 12.26–8 : 12.21. ARRUDA, S. C. Observações sôbre algumas doenças do Eucalipto no Estado de S. Paulo. [**Observations on some diseases of Eucalypts in the State of São Paulo.**] *Biológico* 9 (6), 1943 (140–4). [Port.] R.A.M. 22, 1943 (505).

The most important disease of *Eucalyptus* seedlings in São Paulo is the etiolation and strangulation, followed by rapid wilting and death, caused by *Cylindrocladium scoparium*. Control of the pathogen by soil sterilization with hot water or formalin is a costly process justifiable only for special reasons, the ordinary method consisting in renewal of the soil for greenhouse frames and the application to the walls of creolin or a 5-per-cent. copper sulphate solution. Soils of an unduly compact texture accumulate an excess of humidity favourable to the growth of the fungus.

E. citriodora is the only species which has been observed to suffer from gummosis (*Phytophthora parasitica*). According to E. Navarra de Andrade ('O Eucalypto e suas applicações', Part I, 143 pp., Secr. Agric., São Paulo, 1928), plantings of the same species and *E. robusta* were attacked in the vicinity of the city of São Paulo by *Phytomonas* [*Bacterium*] *tumefaciens*, causing a mortality of 95 per cent., and the writer has also detected the same organism in plants originating in the United States and Chile.

44.3 (83) : 12.26–8 : 12.21. TARTAKOWSY, H., SERGIO, G., and ARENTSENS, S. T. La roya del alamo en Chile. [**Poplar rust in Chile.**] *Bol. Sanid. veg. Santiago* 1 (2),

1941 (21–32). [Min. Agric., Santiago, Chile.] Biol. Abstr. 17 (22548).

Poplar rust was reported in Chile by Spegassini in 1918 and occurs throughout the area in which the Poplar is important. A general discussion is given. The fungus was identified by G. B. Cummins of Purdue University as *Melampsora larici populini*. Injury through defoliation and weakening of trees, and sometimes death, result in serious loss, since the Poplar furnishes important industrial products. Bordeaux mixture at 0·75 to 1 per cent. gave good control on small plants but is impractical on large trees. *Populus nigra italica*, the variety most cultivated in Chile, is most seriously attacked. Several species and varieties of *Populus* have been planted, and preliminary reports on their resistance to rust are given.

44.3–4 (77) : 12.25–8 : 12.21 : 23.27. TEHON, L. R., and CARTER, J. C. **Some important diseases of ornamental trees and shrubs in the mid-west.** *Proc. 18th nat. Shade Tree Conf.* 1942 (169–82). [Illinois Natural History Survey, Urbana, Illinois.]

The main diseases of ornamental trees are grouped according to the species which they most commonly attack. These are shown in the following table:—

Tree species	*Disease*	*Causal agent*
American Elm.	Black leaf spot.	*Gnomonia ulmea.*
	Dothiorella dieback.	*Dothiorella ulmi.*
	Verticillium wilt.	*Verticillium albo-atrum*
	Wetwood disease (Internal slime flux).	Bacteria.,
	Phloem necrosis.	—
	Verticillium root rot.	—
Hard and Norway Maples.	Verticillium wilt.	*Verticillium albo-atrum.*
	Anthracnose	*Gloeosporium* sp.
	Scorch.	
Oak.	Anthracnose.	*Gnomonia veneta.*
	Shoestring rot.	*Armillaria mellea.*
	Cankers and die-backs.	
Poplars and Willows.	Dothichiza canker.	*Dothichiza populea.*
	Cytospora canker.	*Cytospora chryso-sperma.*
Evergreen trees.	Phomopsis twig blight.	*Phomopsis juniperovora.*
	Sphaeropsis tipblight.	*Sphaeropsis ellisii.*
	Rust diseases.	*Gymnosporangium juniperi-virginianae* and *G. globosum.*
	Cytospora canker.	*Cytospora kunzei.*

In each case an indication is given of the symptoms and importance of the disease, and methods of treatment are suggested. The diseases of shrubs included in the review are powdery mildews, bacterial leaf spots and blights, and systemic, canker, and root diseases.

44.4. *Virus Diseases*

44.4. WYND, F. L. **Metabolic phenomena associated with virus infection in plants.** *Bot. Rev.* 9, 1943 (395–465). [University of Illinois.]

44.4 : 12.26–8. TILFORD, P. E. **Phloem necrosis and Elm mosaic: two virus diseases of American Elm.** *Proc. 18th nat. Shade Tree Conf.* 1942 (163–8).

Phloem necrosis of Elm is caused by a transmissible virus; in no case has an infected tree been known to recover from this disease, the symptoms of which are described in the present paper. Although other diseases of Elm may cause dying of roots and foliar symptoms similar to those of phloem necrosis, the typical discoloration of the inner bark and the faint wintergreen odour emitted by moderately discoloured phloem when enclosed in a small stoppered vial or held in the closed hand for a short time are common to no other disease. The infectious nature of phloem necrosis has been demonstrated by grafting, but it is not known how the disease spreads in nature. All attempts at control have met with failure, but there is a possibility that some types of Elm may be naturally more resistant or even immune. The English Elm (*Ulmus campestris*) growing in Columbus has so far shown no signs of the disease.

Elm mosaic, although causing a general decline in tree vigour, resulting in unsightliness, has not so far proved fatal to affected trees. This disease may be transmitted by grafting diseased bark on to healthy trees, but attempts to transmit it by root grafts or by the inoculation of healthy trees with juice expressed from diseased leaves have failed. No information is available as to how the mosaic is transmitted in nature, and no means of control have yet been discovered. The number of trees affected is not large, however, and the spread of the disease seems to be slow.

45. DAMAGE BY ANIMALS

45.3. *Insects*

45.3. ALBRECHT, K. **Insectifuge for wood-destroying insects.** *German Patent* No. 726,644, Sept. 10, 1942 (Cl. 45*l*. 3.08). Chem. Abstr. 37 (6400). P.R.

The trees are sprayed with a mixture of KCN 0·003, creosote 3·5, aloes 1·0, quinone 0·2 and carbolic acid 1,000 g.

45.3 : 01.4 : 23.27. BOYCE, A. M. **Pest control equipment that may be adapted for use on shade trees.** *Proc. 7th West. Shade Tree Conf.* 1940. pp. 8. [Univ. of California Citrus Exp. Sta.]

A review of orchard spraying and dusting methods which are applicable to shade trees. Modern equipment for Citrus and deciduous tree spraying is generally of sufficient capacity for the spraying of most shade trees. Equipment in use in New England for forest spraying develops 1,500 lb. pressure and permits the spraying of trees 12,000 ft. from the spray rig. In general, the solid-stream method is necessary to obtain coverage on tall trees. Types of equipment suitable for spraying and for dusting shade trees are indicated, and reference is made to the atomizing method of application, to dusting and spraying by aeroplane, and to the treatment of limited areas by fumigation.

45.3 (73) : 07.7. HOUSER, J. S. **War-time formulas—insecticides.** With discussion. *Proc. 18th nat. Shade Tree Conf.* 1942 (57–68). [Ohio Agricultural Exp. Sta., Wooster, Ohio.]

There is at present no serious shortage in the United States of the materials required for insecticides to be used during the dormant period. It is recommended, therefore, that dormant sprays should be used for pest

control wherever possible in preference to summer sprays, the supply of which is restricted. Dormant sprays may be used with advantage under present conditions as a general sanitary or clean-up measure to ward off possible pest damage later in the season. Lime-sulphur is available for the control of some scale insects, and there are sufficient supplies of oil emulsions and miscible oils for dormant spraying. Although pyrethrum and rotenone are in short supply, nicotine sulphate can still be obtained. These and other insecticides should be conserved by the addition of wetting and spreading agents. If a suitable wetting and spreading agent is employed, it is unnecessary to use nicotine sulphate stronger than 1 pint per 100 gal. water except in special instances. Arsenicals may be scarce, especially paris green and calcium arsenate. A reasonable quantity of lead arsenate is available, however, and fluorine might be of service in the form of barium fluosilicate. In the event of arsenicals being unavailable the use of tree bands is recommended in areas where cankerworms are abundant.

45.3 (73) : 07.7. BISHOPP, F. C. **War-time entomology. Insecticides—present and future supplies, substitutes, and new materials.** With discussion. *Proc. 18th nat. Shade Tree Conf.* 1942 (48–57). [U.S. Bureau of Entomology and Plant Quarantine.]

The manpower situation is first discussed briefly. The shortage of insecticide supplies at the present time is partly due to the loss of the derris-producing area of Malaya. Rotenone supplies have had to be restricted to army and navy uses, and to the protection of certain food crops. Rotenone-bearing plants are grown to some extent in South America, and trade agreements have been made with Peru and Brazil for supplies of this insecticide. However, the amount available is inadequate for present needs, although it is expected that enough material will ultimately be produced to meet the potential market of roughly 30 million pounds. Until plantings of rotenone-containing species come into full production it will be necessary to rely on substitutes and to restrict the use of rotenone to the control of insects that cannot be controlled by other means or to crops on which it would be dangerous to use insecticides more toxic to man.

The substitutes dealt with include pyrethrum, nicotine sulphate, lead arsenate and cryolite. Supplies of lead arsenate are in the hands of the War Production Board, but the other insecticides mentioned could be made available. In the case of pyrethrum, transport from Kenya constitutes a difficulty. The use of copper (which is a constituent of paris green and bordeaux mixture) is necessarily restricted.

Brief reference is made to the work of the Bureau of Entomology and Plant Quarantine on problems connected with the protection of shade trees. In the discussion, mention is made of a method of killing Elm trees by means of chlorates whereby a 100-per-cent. kill of the bark beetles which attack the dying trees is also achieved. Such trees appear to serve as a trap for bark beetles in their vicinity, and it is possible that the treatment of 2 per cent. of the Elms in a forested region might be effective in assembling all the bark beetles in that area; this work is still in an experimental stage.

45.3 : 07.7. FRENCH, O. C. **Spraying equipment for pest control.** *Bull. Calif. agric. Exp. Sta.* No. 666, 1942. pp. 42.

This publication explains the fundamental mechanics of modern spraying equipment. Sections of the work are devoted to portable power sprayers, stationary spray plants, portable pipe-line systems, air atomizing sprayers, and weed sprayers.

45.3 (75.9) : 13.2 : 23.27. CREIGHTON, J. T. **The control of some of Florida's shade tree pests.** *Proc. 5th Sth. Shade Tree Conf.* 1942 (219–33). [Univ. of Florida, Gainesville, Florida.]

A discussion on the various insect pests which attack the aerial portions of ornamental trees in Florida and on practical methods for their control. The two main groups of insects dealt with are (1) chewing insects (including leaf skeletonizers and miners, grasshoppers, bagworms, tent caterpillars and web worms, borers and bark beetles) and (2) sucking insects (including white flies, scales, aphids, plant bugs, thrips, and red spiders). The latter group constitutes the major pest problem among ornamentals in the state.

45.3 (43.7) : 13.2. KALANDRA, A. Erfahrungen über das epidemische Auftreten des Fichtenwicklers *Epiblema tedella* Cl. in den Jahren 1939–41. [**Experiences on the epidemic occurrence of *Epiblema tedella* Cl. in the years 1939–1941.**] *Cbl. gesamte Forstw.* 69, 1943 (18–27). [G.] [Anstalt für Forstschutz und Jagdwesen in Prag.]

Notes on observations in various localities in Czechoslovakia. Defoliation was most serious, from an economic point of view, in nurseries of ornamentals.

45.3 : 13.2. COLLINS, D. L., and NARDY, R. V. **Bordeaux and other sprays for control of Japanese beetle.** *J. econ. Ent.* 36, 1943 (525–31).

Experiments were carried out with the object of comparing the effectiveness of several sprays against Japanese beetle (*Popillia japonica*) on field plantings of Elm, on potted Elms, and on Bayberry (*Myrica carolinensis*) and some other plants. A combination of lead arsenate and bordeaux mixture was the most effective of the sprays tested.

45.3 : 13.2. CORY, E. N. **Biological control of the Japanese beetle.** With discussion. *Proc. 18th nat. Shade Tree Conf.* 1942 (148–54).

In addition to an extensive trapping programme and the spraying of favoured host plants, attempts have been made in Maryland to control the spread of the Japanese beetle (*Popillia japonica*) by the introduction of various parasites. Two small digger wasps (*Tiphia vernalis* and *T. popillavora*), as well as laboratory-reared nematodes, have given some degree of control, but the main biological factor in combating this insect has been the milky disease caused by a spore-forming bacterium, *Bacillus lentimorbus*. Quantities of spore dust from this organism have been obtained by the rearing of inoculated grubs of the beetle which were ground into a homogeneous mass. The spore dust is standardized at 75 million spores per gram of spore dust, and about 1¾ lb. of dust are required per acre.

In infested areas, where the disease has been distributed, a marked diminution in the number of beetles has resulted. It is hoped, chiefly by means of this parasite, to reduce the status of the Japanese beetle in Maryland to that of a native pest.

45.3 : 13.2 (74.1) : 24.3. BEHRE, C. E., and REINEKE, L. H. **The opportunity for silvicultural control of gypsy moth in southwestern Maine.** *J. For.* 41, 1943 (811–5).

Forest stand data from 15,691 plots, obtained in a survey involving 1,255,000 acres of forest in south-western Maine, are classified on the basis of forest types for resistance or susceptibility to gypsy moth (*Lymantria dispar*) attack, and for priority in silvicultural control treatment. Such treatment should be a primary consideration in any fuelwood operations and may be an important item for a post-war programme of public employment in the region. [Cf. *For. Abstr.* 3 (348).]

45.3 : 12.25 : 13.15 : 13.2. GÖSSWALD, K. Die Massenzucht von Königinnen der kleinen roten Waldameise im Wald. **[Mass breeding in forests of queens of the small red forest ant.]** *Z. angew. Ent.* 29, 1942 (659–83). [G.] R.A.E. 31A, 1943 (451).

The plan to employ the red forest ant, *Formica rufa*, L., against forest pests in Germany depends on efficient utilization of the often scanty populations. Splitting up of nests is uneconomic and not always successful biologically, and a considerable increase in colonies must be based on an increased supply of queens. The author has evolved a method of breeding queens without the high mortality that is common in nature. There are several varieties and forms of this ant, and they differ somewhat in habits. These are reviewed, and it is concluded that the most suitable for distribution are certain forms of *F. rufa rufo-pratensis*, Forel, which are preferable because of their more marked predatory instincts and greater production of queens and nests. Factors that influence pupal development and pairing are discussed. [Cf. *For. Abstr.* 3 (345); 5 (64).]

45.3 : 12.25 : 13.2. GÖSSWALD, K. Ameisenhorste im Massenvermehrungsgebiet von *Diprion pini* L. (Kiefernbuschhornblattwespe). **[Stands protected by nests of ants in an area of *Diprion pini* infestation.]** *Cbl. gesamte Forstw.* 69, 1943 (4–18). [G.] [Institut für Waldschutz, Eberswalde.]

The destruction of larvae of *Diprion pini* by ants was largely responsible for the protection of a number of stands in the area investigated (in the Schorfheide), which, taken as a whole, had been subject to heavy damage. The location of the ant nests and their protective effect were investigated for *Formica rufa rufa*, *Formica rufa rufo-pratensis major*, and *Formica rufa rufo-pratensis minor*, and it is concluded that ant nests, when spaced 50 m. apart, will suffice to keep the sawfly under control. Such nests can be introduced artificially, particularly those of *Formica rufa rufo-pratensis minor*, which is also the most effective of the ants under the prevailing conditions. [Cf. preceding abstract.]

45.3 : 12.25 : 13.2. BOOMSMA, C. D., and ADAMS, A. J. S. **The Pine bark beetle (*Hylastes ater*) at Mount Burr, South Australia.** *Aust. For.* 7, 1943 (33–7).

A brief account is given of the life history, habits and habitat of the Pine bark beetle *Hylastes ater*, which lives and breeds in recently felled material and has been found to increase greatly in numbers following clear-felling operations. The beetle is reported to have caused heavy and repeated mortality of seedlings, but only on those areas where slash has been burned. Methods suggested for the successful re-establishment of Pine where *Hylastes* is common are to plant without burning or, where burning is essential, to allow a rest period of one year between that operation and the planting.

45.3 : 12.25 : 13.2 : 22.1. BEAL, J. A., and MCCLINTICK, K. B. **The pales weevil in Southern Pines.** *J. econ. Ent.* 36, 1943 (792–4). [Duke Univ., Durham, N.C.]

The life history and habits of the pales weevil (*Hylobius pales* Herbst) in the southern States differ somewhat from those recorded for New England. In the vicinity of Durham, North Carolina, there is one complete generation and a partial second overlapping generation annually, the weevil appears to breed only in the roots of stumps and dying trees, and the larvae feed singly. Apparently all species of Pine are liable to attack, and severe damage has been caused to *Cupressus arizonica*. *Juniperus virginiana* is also attacked to some extent. Damage is proportional to the size of the trees and to the number of weevils present. Young Pines from the seedling stage up to 4 or 5 feet in height suffer most severely, especially if they are in the vicinity of freshly-cut stumps, dying Pines, or of logging or building operations. The weevil is attracted to the vicinity of Pines infested by bark beetles, and feeds upon the surrounding reproduction and the limbs of infested trees, and later breeds in the roots. Losses have been noticeably heavier in areas under the group selection method of cutting than where clear cutting in strips is the method used.

45.3 : 12.25 : 12.14.7 : 13.2. MACKAY, J. W. **Grubs in Norway Spruce cones.** *Scot. For. J.* 57, 1943 (54).

The presence of larvae of *Cydia strobilella* and *Megastigmus spermotrophus* in the cones of Norway Spruce is reported from the south of Scotland. The early extraction of seed and destruction of cones and light seed are suggested as the only practicable control measures.

45.3 : 12.25 : 12.14.5–7 : 13.2. MACKAY, M. R. **The Spruce foliage worm and the Spruce cone worm (*Dioryctria* spp., Lepidoptera, Pyralidae).** *Canad. Ent.* 75, 1943 (91–8). I.I.E.

A detailed description is given of two species of *Dioryctria* which feed on Spruce in North America. One species, *D. abietella* D. and S., normally feeds in the young Spruce cones and occasionally on the foliage of nearby twigs, while the other, *D. reniculella* Grt., feeds mainly on the foliage of the terminal shoots. *D. abietella* appears to be identical with the Spruce cone worm found in Finland. The original mistaken description of *D. reniculella* as the Spruce cone worm reveals no reliable points of difference from *D. abietella* in the gross examination of the adult, and there seems no reason why this description should not apply to the adult of the foliage species; specialists of the United States National Museum and the Canadian National Collection concur in this view.

The hosts of the Spruce foliage worm are White, Black, Engelmann, and Blue Spruce, and very occasionally Balsam Fir, Tamarack and Jack Pine. In north-western Ontario this species was observed to be predacious on the Jack Pine budworm. It generally occurs in areas infested by the Spruce budworm (*Cacoecia fumiferana* Clem.).

45.3 (496) : 12.25–8. ACATAY, A. Über das Auftreten von Forstschädlingen in der Türkei. **[On the occurrence of forest pests in Turkey.]** *Cbl. gesamte Forstw.* 69, 1943 (1–14). [G.] [Institut für Forstentomologie und Forstschutz der forstlichen Fakultät in Bahçeköy, Türkei.]

Observations made in the Alatsham forests near Dursunbey in Western Anatolia. The various insect pests observed on *Pinus nigra* (the principal species in these forests), *Quercus* spp., and other tree species are noted briefly.

45.3 (68) : 12.25–8 : 13.2 : 31.43. TOOKE, F. G. C. **Progress of forest entomology in South Africa.** *J. S. Afr. For. Ass.* No. 10, 1943 (4–12 + plates).

Notes are given on the occurrence, economic importance and control of a number of insects that attack forest trees and timber in South Africa. They include *Gonipterus scutellatus* and *Phoracantha semipunctata* that attack *Eucalyptus* species, *Nudaurelia cytherea capensis*, *Euproctis terminalis* and *Heliothrips haemorrhoidalis* that attack conifers, and a number of insects of minor importance. Measures are recommended for preventing damage by *Lyctus* and other beetles to sawn timber.

45.3 (74.7) : 12.25–8 : 13.2. STONE, E. L., and SCHWARDT, H. H. **White grub injury to young plantations in New York.** *J. For.* 41, 1943 (842–4). [Cornell Univ.]

A brief account is given of the life cycle and feeding habits of May beetles, the number of which in New York State has shown a considerable increase in recent years. The larvae or white grubs cause extensive damage in nurseries and young plantations. Direct control does not appear to be practicable, and suggestions are made for minimizing the opportunities for injury to occur by restricting planting in predicted 'grub' years to the less susceptible cover types and to areas where the grub population is known to be relatively low.

45.3 : 12.26–8 : 13.2 : 23.27. FLINT, W. P., and FARRAR, M. D. **Control of shade tree insects.** With discussion. *Proc. 18th nat. Shade Tree Conf.* 1942 (139–48). [State Natural History Survey, Urbana, Illinois.]

A discussion on the use of dormant and summer sprays. Formerly caustic and irritating lime-sulphur sprays were used almost exclusively for insect control during the dormant period, but their place has now largely been taken by the safer miscible oils. During recent years the killing power of these oils has been increased by the addition of DN compounds consisting mainly of oil-soluble dinitro-o-cyclo-hexyl phenols and dinitro-o-cyclo-hexyl cresols or their water-soluble sodium salts. Soybean flour is recommended as an emulsifying agent for oil sprays.

Various liquid summer sprays for use in the control of leaf-eating insects are also discussed. In some cases dusting instead of spraying might be done with advantage. A mixture of wide application which can be used on tender foliage consists of 75 lb. dusting sulphur, 15 lb. hydrated lime, and 10 lb. lead arsenate.

Formulae are given for several dormant and summer sprays which are particularly recommended.

45.3 (54.8) : 12.26–8 : 13.2. ANANDA, RAU, S. **Report of the Entomologist 1941–42.** *Rep. sci. Dep. Tea Sect. U.P.A.S.I. 1941–42*, 1942 (18–26). R.A.E. 31A, 1943 (452–3).

A species of *Kalotermes* was reported from trees of *Grevillea* that were dying back, but the exact nature of the damage could not be ascertained. *Albizzia* was attacked by an undetermined Hepialid referred to as *Phassus* sp. which bored in the main stems of young *Albizzia* plants and was also reported from young plants of Red Gum (*Eucalyptus rostrata*), and by a species of *Indarbela*, probably *I. quadrinotata*, Wlk., attacking the bark in south Travancore. Extensive outbreaks of the latter borer are generally regarded as indicating an unhealthy condition of the trees. A combined severe attack of the Membracid, *Oxyrhachis tarandus*, F., and a species of *Pseudococcus* was observed on a large number of *Albizzia* trees on an estate in south Travancore. Pierids of the genus *Terias*, which occasionally defoliate *Albizzia*, were also reported from south Travancore and from the Anamallais. The pentatomid, *Cyclopelta siccifolia* caused considerable damage to Dadap (*Erythrina*) on an estate in south Travancore, the nymphs and adults feeding on the sap of the twigs in large numbers.

45.3 : 12.26–8 : 13.2. BOSQ, J. M. Un taladro dañino para nuestros frutales y forestales, *Praxithea derourei* (Chabrill). **[A borer injurious to our fruit and forest trees, *P. derourei*.]** *Alm. Minist. Agric. Argent.* 17, 1942 (425–30). [Span.] R.A.E. 31A, 1943 (477).

The Cerambycid, *Praxithea derourei*, Chabrillac, which occurs in Brazil, Uruguay and Argentina, attacks ornamental and forest trees and many fruit trees, and has destroyed entire orchards near the city of Buenos Aires. Its synonymy is discussed, the adult and larva are briefly described, and methods of control are indicated.

45.3 : 12.26–8 (43.1–5) : 12.19 : 13.2 : 13.14–5. ZIELK, O. Ueber die Eschenwollschildlaus, *Fonscolombea fraxini* (Kalt.) Ckll. (Hem. Cocc.), und die standörtlichen Befallsverhältnisse bei der Esche, *Fraxinus excelsior* L. **[On the Ash scale, *Fonscolombia fraxini*, and the local conditions governing infestation of the Ash, *Fraxinus excelsior*.]** *Arb. biol. Reichsanst.* 23 (3), 1942 (293–386 + plates). R.A.E. 31A, 1943 (437).

Numerous colonies of *Fonscolombia fraxini*, Kalt., occur regularly on Ash trees in the streets of Berlin, but trees in the outer districts of the city are often uninfested and show a difference in mode of growth. The author has investigated the causes of this difference and has also made observations on forest-grown Ash. He gives a detailed account of the nomenclature, synonymy, distribution, morphology, anatomy, biology and natural enemies of *F. fraxini*, and of the ecology in forests and in Berlin of the Common Ash (*Fraxinus excelsior*), which is its chief food-plant and the only one heavily infested by it, and concludes that this insect is a secondary pest, attacking only weak trees, and that heavy infestations indicate that the soil and environment are unfavourable.

45.3 : 12.26–8 : 13.2. FISHER, R. C. **Ash bark-beetle damage; an alarming but unimportant type of insect attack in Ash.** *Repr.* from *Aircraft Engng.* Aug. 1943. p. [1].

The Ash bark beetle (*Hylesinus fraxini*) bores into the bark of logs, stumps, or converted unedged timber, but does not damage the timber other than by occasionally penetrating the sapwood. Features distinguishing infestation by this insect and by *Lyctus* beetles are summarized briefly.

45.3 : 12.26–8 : 13.2. MÜLLER, H. Massenhaftes Auftreten der Grossen Buchenblatt-Gallmücke. **[Epidemic occurrence of the Beech leaf gall midge.]** *Schweiz. Z. Forstw.* 93, 1942 (330–2). [G.]

Cecidomyia fagi occurred epidemically in the Glarus canton in the summer of 1942. Damage was of a minor and temporary nature.

45.3 : 12.26–8 : 13.2. JONES, M. G. **A brown aphis, *Aphis* (*Doralis*) *cognatella* sp. n. found on Spindle tree.** *Bull. ent. Res.* 34, 1943 (213–24). [Department of Zoology, Cambridge.]

A brown, monophagous aphid, *Aphis* (*Doralis*) *cognatella*, closely allied to the polyphagous species, *A. fabae*, has been recorded in Great Britain from *Euonymus europaeus* and *E. hamiltonianus*. *A. cognatella* is described and compared with *A. fabae*. Outdoor transference experiments showed that *A. cognatella*, although found normally on *Euonymus* sp., can exist for some time on several other named plants which are also hosts of *A. fabae*.

45.3 : 12.26–8 : 13.2. TAHER SAYED, M. **Contribution to the knowledge of the Acarina in Egypt. I. The genus *Raoiella* Hirst (Pseudotetranychinae—Tetranychidae). II. The genus *Tenuipalpus* Donnadieu (Tetranychidae). III. The genus *Phytoptipalpus* Trägårdh (Tetranychidae). IV. The genus *Anychus* McGregor (Tetranychidae).** *Bull. Soc. Fouad Ier Ent.* 26, 1942 (81–4, 93–8, 115–7, 125–7 + plates). R.A.E. 31A, 1943 (441).

Descriptions are given of the Egyptian species of the four genera dealt with, and the characters and systematic position of the first three are discussed. Among the species included are *Phytoptipalpus paradoxus*, Trägårdh, on *Acacia nilotica*, and a species of *Anychus* on the leaves and fruits of Citrus, on castor (*Ricinus communis*), and on some ornamental trees such as *Melia azadirachta* and *Albizzia lebbek*.

46. DAMAGE BY MAN

46 (47.1) : 43.3. Krigsskador på finska skogar. **[War damage in Finnish forests.]** *Skogen* 30, 1943 (81). [Sw.]

According to valuations made up to the present, damage amounting to approximately 430 million Finnish marks has been caused in an area of 180,000 ha. of Finnish forests. Along some of the railways and the more important main roads cutting has also been carried out so that large areas are practically bare. Forest fires, due to the war, have contributed very largely to the destruction. R. P. J.

46 : 12.26–8 : 23.27. FENNER, C. **Shade method of direct cambium-to-bark development.** With discussion. *Proc. 18th nat. Shade Tree Conf.* 1942 (131–8).

As a result of the observation that bark-deep wounds on the north or shaded side of a tree often developed healthy bark directly from cambium in instances where no dressing was applied, while the exposed cambium on the sunny side of the trees died, experiments were undertaken to test the effect of artificially shading all bark-deep tree wounds where the cambium was uninjured. Good results have been reported in the case of Elms, Maples and Hackberry.

5. MENSURATION. INCREMENT. YIELD

52. MEASUREMENT OF TREES AND TIMBER

52.1. *Diameter. Girth*

52.1 : 21.61 : 11.12. TISCHENDORF, W. **De rEinfluss der Exzentrizität der Schäftquerflächen auf das Messungsergebnis bei Bestandesmassen ermittelungen durch Kluppung. [The effect of eccentricity of the bole cross section on the results of measurements of stand volume made by means of callipering.]** *Cbl. gesamte Forstw.* 69, 1943 (87–94). [G.]

Experimental evidence from Spruce, Silver Fir, Scots Pine and Beech stands supports the theory that the larger diameter of eccentric cross sections of stems tends to coincide with the direction of the prevailing wind; hence callipering in this direction will generally result in a positive error, while a negative error will occur when the callipering is done at right angles to the prevailing wind. The error involved can be offset in several ways, e.g. by callipering at an angle of 45° to the direction of the prevailing wind.

52.1–2. DAVEY, R. **Perspective in relation to the measurement of standing trees.** *J. For.* 41, 1943 (895–7).

This article discusses the errors introduced by perspective in ocular estimates of tree heights and diameters. It is concluded that such estimates are so greatly influenced by the personal factor that it is neither practicable nor worth while to systematize the fundamental sources of error, and that the use of taper tables and of an instrument for the measurement of height reduces the personal factor to a minimum and is therefore highly desirable.

52.4. *Measurement of Volume*

52.43.2 : 53. WUOTI, E. **The relation between solid volume and the stacked measure for Spruce sawtimber and its dependence on the stem form.** *Acta for. fenn.* 50 (18), 1942 (1–40). [Finn.g.] S.P.S.

In Finland timber of sawlog size is bought by the lumber industry on the basis of solid volume in cubic feet and by the pulp and paper industry on the basis of stacked measure in cubic meters. The relation between these two measurements, which is an important factor in comparing the prices paid by the two industries, is discussed with reference to stem form.

52.43.3. GRAY, H. R. **Volume measurement of forest crops.** *Aust. For.* 7, 1943 (48–74).

The literature relating to the form quotient theory is reviewed. A hypothesis is put forward that within the usual limits of accuracy of tree measurement, the central length of the bole, underbark, approximates as closely to a solid body generated by a second degree parabola as to any other geometrical body, even though variation of form quotient may be considerable. The hypothesis has been tested statistically on data of a number of species growing in different localities and conditions.

If values of sectional area in the main stem are plotted against height, the 'taper line' connecting these variables can be projected upwards to cut the vertical axis at parabolic height and downwards to cut the horizontal axis at parabolic base.

In the case of stems of *Pinus radiata*, of several other introduced conifers and of a number of *Eucalyptus* species studied, visual approximation to the 'conical' or a 'cylindrical' shape is due to (*a*) variation of absolute taper and (*b*) variation of the proportion of the whole stem influenced by 'top' and 'butt'. Excluding 'top' and 'butt' and 'unrepresented points', differential diameter thickening along the main stem results chiefly from differences in the ratio:—rate of height growth/rate of diameter growth.

The use of the above hypothesis provides the most satisfactory means of volume estimation of single trees yet available and therefore the most satisfactory basis for all management studies. *From author's summary.*

52.43.3 : 12.25 (74.1). **Second-growth White Pine volume table: southwestern Maine.** [Maine University Agricultural Extension Service.] [1943.] pp. [5].

52.5. *Measurement of Bole Area*

52.5 : 56. LEXEN, B. **Bole area as an expression of growing stock.** *J. For.* 41, 1943 (883–5). [Rocky Mt. Forest and Range Exp. Sta.]

Although volume of timber gives a good measure of wood capital in a residual stand, it is not necessarily a good indicator of the potential growth of the stand. This depends primarily on the amount of stem cambium, which can best be indicated by the measurement of the bole area. This article illustrates the usefulness of bole area in predicting future growth and shows how it may be calculated for single trees or stands.

54. FACTORS CONNECTED WITH ASSORTMENT

54 (4) : 33.02. SCHMIDT, E. Vorschläge zu einheitlichen Umrechnungszahlen für die Faserholzverarbeitung. **[Proposals for the adoption of standard conversion factors in calculating the consumption of wood by the pulp industries.]** *Holz* 6, 1943 (50–4). [G.g.] P.R.

A report presented at a session of the 'Arbeitsgruppe Holztechnik' of the 'Kommission zur gemeinsamen Behandlung der Holzbedarfsdeckung in den Ländern Europas', one of the aims of which is to lay down conversion factors applicable to the whole of Europe. The writer discusses the application of various conversion factors in calculating the wood consumed per unit pulp under German conditions.

56. INCREMENT

56 : 12.25 : 22.83. LAPPI-SEPPÄLÄ, M. **On the growth of Siberian Larch in the mixed stands of the Crown forest of Evo.** *Acta for. fenn.* 50 (8), 1942 (1–19). [Finn.g.] S.P.S.

Larch (*Larix siberica*) in a mixed stand was found to grow faster than the Spruce and Pine in the same stand but not so fast as Larch in a pure stand.

56 : 12.26–8 : 12.25. ORDING, A. **The Oak forest in Aust- and Vestagder.** *Medd. norske Skogforsøksv.* No. 29 [Vol. 8, No. 3]. 1942 (367–421). [Nor.g.] S.P.S.

A study was made to compare the growth of *Quercus sessiliflora* and *Q. pedunculata* (*robur*) and to compare the economy of Oak forest with that of Spruce or Pine. Measurements were made by the author of 2,100 sample trees of Oak and 600 each of Spruce and Pine, and, in addition, data were obtained on 365 Oaks from national forest survey records. It was found that for the same diameter *Q. sessiliflora* is consistently taller than *Q. pedunculata*; both species appear to grow better near the coast than inland. In the coastal region the relation in diameter growth of Spruce, Pine and Oak is shown by the figures 100, 82·6 and 73·3 respectively.

56.02 : 12.25 (78.2) : 11.14.3. WEAKLY, H. E. **A tree-ring record of precipitation in western Nebraska.** *J. For.* 41, 1943 (816–9). [Univ. of Nebraska, Lincoln, Neb.]

A study of tree rings in carefully selected specimens of Red Cedar and Ponderosa Pine from various parts of western Nebraska shows that for the last 400 years there have been frequent dry years or short periods of dry years, with less frequent droughts lasting for 5 years or more.

56.05 : 12.25. LANGSAETER, A. **Relation between the prices of different dimensions and quality increment of Spruce.** *Medd. norske Skogforsøksv.* No. 23 [Vol. 6, No. 4]. 1939 (497–532). [Nor.] S.P.S.

Data are given for use in determining the quality increment of Spruce trees.

56.2. CHEYNEY, E. G. **On the prediction of forest growth.** *J. For.* 41, 1943 (761–2). [University of Minnesota.]

Growth figures obtained by careful measurement and computation are too costly for general use in practical forest management, and it is suggested that for this purpose, prediction of growth should be based on an estimated growth per cent.

56.2 : 52.43 : 66. MEYER, W. H. **Amortization in stand-growth and depletion problems.** *J. For.* 41, 1943 (920–2). [Yale University.]

Two formulae are given which incorporate the amortization principle in the solution of several types of problems involving growth and depletion predictions for forests under operation. The formulae are:—

$$(1)\quad V_n = V_o\,(1+g)^n - \frac{A}{g}\,[(1+g)^n - 1]$$

$$(2)\quad (1+g)^N = \frac{A}{A - V_o g}$$

where V_n is volume after n years.

V_o is volume at the beginning of the prediction period.

g is annual rate of growth, expressed in decimals.

n is the number of years in the prediction period.

A is the annual cut.

N replaces n when total length of the period of liquidation is involved.

It is pointed out that, as the compound interest theory is involved, when long periods of prediction are considered the problem must be solved by a series of calculations, a new rate of interest being introduced as new conditions affect the growth of the stand.

6. MANAGEMENT. WORKING PLANS. SURVEYS

60. GENERAL LAND MANAGEMENT

60.3. *Management of Different Classes of Forest*

60.3 (494). FANKHAUSER, F. Das bernische Forstwesen. **[Bernese forestry.]** *Schweiz. Z. Forstw.* 94, 1943 (201–23 + plates). [G.]

An account of the history of forestry in this canton and of present forestry conditions.

60.31 (485) : 66. JOHANSSON, S. Intensiv skogsvård i Norrlandsskogarna. **[Intensive forest improvement in the Norrland forests.]** *Skogsägaren* 18, 1942 (202–6). [Sw.]

Fifty-seven per cent. of the land area of Sweden consists of forest. Norrland, in particular, has extensive forest areas; as a result of accurate surveys in its Lapp territories the most detailed and reliable information on forest production is available.

At present depletion from these forests exceeds the growth, as large quantities of old overmature forest have had to be felled. Within the next few years, when most of the old timber has been removed, felling budgets will have to be kept within the limits of growth. If in the future Sweden is to maintain her profitable export of wood products all measures must be used to intensify forest improvement, particularly in the Norrland forest tracts, and to bring all land suitable for afforestation into a productive condition.

Work in the forests has proved so profitable to the Norrland peasants that agriculture has been neglected. Rational management of the soil is of the greatest importance.

Some of the larger companies have done good work in forest improvement and measures have to some extent also been taken in the State forests to keep the land in good production. The State has for a long time shown its interest in forestry and has made grants for forest improvement within the area to which the 1932 forest improvement law applies, and also in commonland forests and shelterbelts in Norrland. R. P. J.

60.31 (485) : 12.25 : 11.49.5 : 22.11 : 22.14.1. HOLMGREN, A. Bidrag till kännedomen om de norrlandska gamla råhumus granskogarna med särskild hänsyn till deras avverkning och föryngring. **[The old Spruce forests of raw humus type in Norrland and their regeneration.]** *Norrlands SkogsvFörb. Tidskr.* 1942. (127–94). [Sw.] S.P.S.

Following an historical account of forest development in Norrland and of the competition between the methods of selection cutting and clear cutting, the author gives the results of investigations made on areas treated by the selection system. The very old Spruce stands of Norrland react unfavourably to this treatment: the residual trees are damaged by storms, insects and disease, the raw humus does not decompose, and there is no natural reproduction. The final operation must be clear cutting followed by artificial regeneration.

60.31 (71) : 91.8. KENNEDY, H. **Greater forests for a greater Canada.** *Timber of Canada* 4 (1), 1943 (103–4, 106–7, 166, 168).

Suggestions are made for the improvement of forest conditions in Canada with particular reference to the use of unemployed labour after the war. Some major forest projects that might be included in a post-war rehabilitation programme are listed.

60.31.2 (481). BØHMER, J. G. **Planning for the management of the farmer's woodlot.** *Tidsskr. Skogbr.* 1941 (110–17). [Nor.] S.P.S.

60.31.2 (481). BLAKSTAD, L. **Planning for the management of the farmer's woodlots.** *Tidsskr. Skogbr.* 1941 (103–10). [Nor.] S.P.S.

Woodlots belonging to farmers and otherwise related to agriculture make up 60 per cent. of the forest area of Norway. It is important for the economy of the country that the management of these forests should be well organized. A committee of the Forest Society and a government committee have been working on the subject. For each forest a map should be made, the distribution of wood capital by age classes and site quality classes should be determined, and a plan should be made for management during the next ten years.

60.31.2 : 66 : 92 : 94.3. LUNCZ, G. Les récentes mesures législatives visant à accroître le rendement des forêts privées. **[Recent legislative measures aiming at increasing the yield of private forests.]** *Intersylva* 2, 1942 (508–16). [F.g.e.span.ital.]

A brief review of legislation affecting private forests in different countries.

61. SURVEYING. MAPPING

61 : 07.7. BRYAN, M. M. **Area determinations with the modified acreage grid.** *J. For.* 41, 1943 (764–6). [Forest Service, Atlanta, Ga.]

An improved grid method is described for quick and accurate determination of acreages of areas on maps or photographs of any scale. Squares are drawn on transparent celluloid which is used as an overlay of the map to be measured. In the grid described, each square inch is divided into 16 squares in each of which are placed 4 equally spaced dots. For any particular area the value of each dot is determined by dividing the acres per sq. in. on the map by 64. The number of dots inside the area to be measured, multiplied by this converting factor, will give the acreage.

61.32. WIESLANDER, A. E., and WILSON, R. C. **Classifying forest and other vegetation from air photographs.** *Photogram. Engng.* 8, 1942 (203–15). [California Forest and Range Exp. Sta.]

A method of classifying vegetation from air photographs has been developed in connexion with the mapping of some 70 million acres in California and western Nevada. The vegetation of the area includes timber stands, cordwood stands, shrub growth, chaparral, grass, sagebrush and subalpine vegetation. Elevations range from below sea-level to 15,000 ft.

The objectives of the classification are stated as follows:—'1. To provide maps showing the kind, character, and distribution of the natural vegetation of forest and related lands as a basis for wise management of timber, range, water, recreation, and wildlife resources. 2. To facilitate estimation of the volume of timber and cordwood in the region as part of the Federal nation-wide forest survey and to localize such estimates by county units'.

The method of classification has been developed for use with summer photographs and a scale of 1 : 20,000, which is considered best adapted to the variety of uses for which aerial photographs are required; adequate base maps, prepared from air photographs, are essential.

Skill in the interpretation of air photographs depends largely on experience and general knowledge of the region to be mapped. The photographic appearance of vegetation elements and other features on air photographs varies with topographic situation, season, and time of day; definitions of photographic characteristics of the vegetation are unlikely to fit all cases but are of value nevertheless in identification. As a basis for the present classification the photographic characteristics of vegetation elements (timber trees, cordwood trees, shrubs, herbs), age-class elements (small immature timber trees, etc.) and other features are defined and illustrated. Classes are developed for application to all lands except cultivated, urban, and industrial areas and apparently barren areas. These are:—(1) vegetation classes including (*a*) areas essentially composed of a single vegetation element, and (*b*) areas in which two or more vegetation elements are significant (in general occupying 20 per cent. or more of the ground space or forming 20 per cent. or more of the total vegetation cover); (2) density classes (dense, semi-dense, open and

very open); and (3) age-structure classes (old growth, old growth–young growth, young growth–old growth, young growth).

The vegetation classes are identified on the photograph by the use of magnifying stereoscopes, the boundaries are demarcated and appropriate symbols are marked on each type for purpose of future reference. Where two or more vegetation or age-class elements occur in a single classification, the symbols are listed in order of the relative area occupied by each element.

Classifications are transferred from single photographs to the base map by means of a reflecting projection machine, and, in order to keep corrections for relief distortion and tilt displacement at a minimum, only the central portion of each photograph is used. The photographs thus classified are used as the basis for four series of maps for particular uses; in some cases supplementary field data are required for this purpose.

The maps developed from the photographs include:—

(*a*) Maps showing vegetation classes for all lands and densities of tree and shrub cover. The information is obtained entirely from an office study of the air photographs.

(*b*) Maps showing vegetation types by species composition. Supplementary office and field work is required in the preparation of these maps. The air photographs showing vegetation classes and densities are taken into the field and further classified on the basis of pure, simple mixed and mosaic mixed stands, the boundaries of these associations being delineated on an overlay of transparent cellulose acetate; this may or may not require subdivision of the vegetation classes used on the photographs. Sample plots are useful in verifying dominants of an association and in obtaining details for the proper description of associations.

(*c*) Maps showing age structure and density classes. For timbered areas these maps show (1) composition by vegetation elements, (2) timber-tree composition according to age classes present, (3) age-structure classes, and (4) stand density of timber trees. For cordwood areas they show (1) composition by vegetation elements, (2) age-structure classes, and (3) stand density of cordwood trees. All the necessary information is obtained from an office study of the air photographs.

(*d*) Maps showing species belts and site-quality classes for all timber sites, and species belts of cordwood stands for non-timber sites. The species belts are derived directly from map (*b*) above and data for site-quality classes, based on the age-height relationship of average dominant trees expressed in terms of height attained at 300 years, are obtained in connexion with the field work for that map.

61.32 (47.1). SARVAS, R. **On the importance of air photogrammetry in our forestry**. *Silva fenn.* No. 48, 1938. (1–45). [Finn.g.] S.P.S.

Aerial photography has been used in connexion with mapping in Finland since 1927. This method is not considered to be satisfactory for making forest-crop assessments as it does not give the necessary information on forest condition and growth.

65. DESCRIPTION OF GROWING STOCK

65 : 12.26–8 (77.4–6) : 76.1–2 : 52.42 : 33.91. **Comparison of investment and earnings of hardwood trees in the northern Lake States**. U.S. Forest Service, Milwaukee, Wisconsin. 1942. pp. 69 + plates.

This booklet gives definitions and illustrations of a series of ten tree classes for northern hardwoods, based on present lumber value of the tree, its vigour of growth and the risk of survival for a future cut. The value classification is determined by the grade of the butt log or the first log of the tree that can be utilized, and the vigour and risk class is determined by the visible condition of the crown, bole, and butt of the tree. Basic volume and value data are tabulated for each tree class and tree size for Sugar Maple (*Acer saccharum*), Yellow Birch (*Betula lutea*), and Basswood (*Tilia americana*).

65.1 : 57.0 : 11.22. RÍHA, V. Pěstění lesní zásoby. [**Growing-stock management.**] *Lesnická Práce* 21 (11/12), 1942 (419–47). Biol. Abstr. 17 (25055).

A favourable stand climate is essential for maintenance of high soil productivity and the most valuable growing stock. To create and maintain a favourable stand climate, there must be a several-storied structure of the stand, with 3 categories of trees: the main timber species, a supplementary species to utilize root space not required by the main species, and a subordinate species that helps to create the stand climate.

65.7. MULLOY, G. A. **Stand density units**. *Silvic. Leafl. Dom. For. Serv.* No. 16, 1943. pp. [2].

Cf. *For. Abstr.* 5 (146). Stand density indices are tabulated by diameters. To obtain the density of a particular stand it is necessary first to determine the average diameter; the stand density index for that diameter is read from the table and multiplied by the number of trees per acre.

65.7 : 56.01. TURNER, L. M. **Relation of stand density to height growth**. *J. For.* 41, 1943 (766). [Utah State Agricultural College.]

Examples of a positive correlation between stand density and height growth are reported for stands of Shortleaf and Loblolly Pine (*Pinus echinata* and *P. taeda*). The author suggests that this differential growth may be due, in part at least, to the ratio of available carbohydrate to available nitrogen.

7. FOREST ECONOMICS, VALUATION, AND FINANCE

7 (4). HAGFORS, E. A. M. **Critical investigations on the economic theory of forestry, especially regarding the conditions of northern Europe**. *Acta for. fenn.* 47 (2), 1940 (1–194). [G.] S.P.S.

The author goes back to Pfeil and the generation before the Pressler period. Among the modern writers on forest economics, he is especially interested in Ostwald and Von Wieser. He distinguishes between industrial and forest production and denies the possibility of using the same calculations for them both. The forest is a 'specific producing capital', a rent capital, quite different from the interest capital of industry. From this he concludes that calculations of the cost of production in forestry have no meaning and that rate of interest is of no real importance in forestry. In fact, there is no purpose in talking about production in forestry as the growing of trees is a natural process which is not in any way influenced by the markets for capital or money. Furthermore, the value of the soil cannot be distinguished from the value

of the trees growing thereon. Forest valuation should be made with reference to a complete forest and not to a single stand.

74. VALUE OF THE STAND. VALUE OF THE FOREST

74. SAARI, E **The estimation of the value of large forest areas.** *Silva fenn.* No. 55, 1940 (1–41). [Finn.g.] S.P.S.

The value of a forest might be calculated as the price of the wood following clear cutting plus the value of the soil; however, this method can be used only when clear cutting does take place. It has also been recommended that the value of a forest be calculated by capitalizing the value of the increment—a method that may give too low values.

74 : 12.25 : 12.26–8. GRØN, A. H. Balance og Ventemassetabeller for Rødgran og Bøg. [**Tables of 'balance figures' and expectation values for Spruce and Beech.**] *Dansk Skovforen. Tidsskr.* 1942 (1–76). [Dan.] S.P.S.

Data are given to supplement yield tables for use in calculating soil and expectation values.

74.1. KELTIKANGAS, V. **The soil value in the economics of forestry.** *Acta for. fenn.* 47 (4), 1940 (1–112). [Finn.g.] S.P.S.

The author demonstrates the need in forestry for distinguishing between soil value and the value of the growing stock. This is important in determining the economic value of soil improvements, such as drainage, or of damage as from forest fires. It requires a classification of site quality and information on the relative value of the soil of each site class. The author prefers Cajander's forest-type classification to that based on age and average height of stand.

74.1 : 76.2. STREYFFERT, T. De skogsekonomiska teoriernas praktiska tillämpning. [**The practical application of theories of forest ecnomics.**] *Norrlands SkogsvFörb. Tidskr.* 1940 (25–42). [Sw.] S.P.S.

The soil rental theory introduced by Pressler in 1858 has never been accepted by practical forestry as it leads to excessively short rotations and low incomes. To some extent this is due to an error in calculating the soil expectation value using Faustmann's formula, whereby the annual maintenance costs are assumed to be constant throughout the rotation, which they are not. But the chief reason for the lack of agreement between the theory and the practice is the fact that a static theory cannot cover a dynamic process.

74.2 : 12.25–8. LIHTONEN, V. **On the realization value of the timber crop and its calculation.** *Acta for. fenn.* 50 (10), 1942 (1–30). [Finn.g.] S.P.S.

The value of timber that can be felled is not always equal to the market price for the forest as a whole: if the forest is large the realization value will be lower, and if small it will sometimes be higher than the market price. Evaluation can be facilitated by the use of a formula characterizing the composition and structure of the forest crop and taking into consideration the percentage of timber that can be used for sawlogs. Relevant data are tabulated for Pine, Spruce and Birch.

76. MANAGEMENT STATISTICS

76.1 (489) : 98.1 : 12.25. GRØN, A. H. Produktionspriser for Dansk Rødgran 1941. [**The cost of production for Danish Spruce in 1941.**] *Dansk Skovforen. Tidsskr.* 1941 (185–98). [Dan.] S.P.S.

It is shown that the cost of production for Spruce wood in Denmark in 1941 was greater than the fixed maximum prices.

76.1 : 32.3 : 33.17 : 22.14.2 : 82. KIRKLAND, B. P. **Productivity of logging and sawmill labor as affected by tree size.** *J. For.* 41, 1943 (869–72). [U.S. Forest Service, Washington, D.C.]

Results of logging and milling time studies made in forest regions in the eastern United States are summarized in terms of man-hour cost, and their use in estimating present current costs in money is illustrated. It is indicated that in most cases operating margins of at least $10 per thousand bd. ft. can be realized where cutting is confined to trees 15 in. d.b.h. and larger.

76.1–2 : 60.31.2 : 12.26–8. MONROE, A. F. **Financial returns from Oak-Hickory farm woodlands in Michigan.** *J. For.* 41, 1943 (762–4). [Soil Conservation Service, Howell, Mich.]

76.3 : 12.26–8 : 63. INDIA and BURMA. **Forest research in India and Burma, 1941–42. Part 1.—The Forest Research Institute.** Forest Research Institute, Dehra Dun. [1943?] pp. 151 + plates.

Investigations have shown that the net price per cu. ft. for Teak in the Bori forest of Hoshangabad Division, Central Provinces, varies directly with age and size of tree; the price per cu. ft. continues to increase with age up to 120 years. The mean annual commercial timber volume and value increments culminate at a point beyond the age of 120 years (pp. 29–30).

9. FOREST POLICY

90. GENERAL PRINCIPLES OF FOREST POLICY

90 (73) : 60.31. WATTS, L. P. **Comprehensive forest policy indispensable.** *J. For.* 41, 1943 (783–8). [U.S. Forest Service, Washington, D.C.]

The writer reviews briefly the war-time activities of the U.S. Forest Service, emphasizes the need for constructive planning to enable forests to meet adequately post-war requirements, and urges the adoption of a comprehensive national programme in forestry. Three main lines of public action are advocated—regulation of forest practices on private lands, aid to forest landowners, and increased public ownership.

90 (74.8) : 60.3. WIRT, G. H. **A half-century of forestry in Pennsylvania.** *J. For.* 41, 1943 (730–4). [Pennsylvania Department of Forests and Waters, Harrisburg, Pa.]

A brief historical account of the progress of forestry and forest policy in Pennsylvania since 1893 when a commission was appointed to investigate forest conditions and related problems in that State.

91. SOCIAL AND ECONOMIC SIGNIFICANCE OF THE FOREST

91 (54). HEWETSON, C. E. **Programmes.** *Indian For.* 69, 1943 (428–31).

The author believes that the forests and wood-using industries of India ought to be retained as a permanent part of the state economy and suggests that the authorities issue a charter which will specify:—(1) the purposes

for which timber and wood products are to be used and for which substitutes are forbidden; (2) the areas to be set aside for forests and the production of timber, with regulations to ensure the maintenance of productivity; (3) the building up of reserves; (4) the recognition of certain forest areas as the rightful living space of the aboriginal inhabitants; and (5) the provision of national parks.

In order to accomplish these aims a three-fold programme of research, education, and organization is required. The central research station at Dehra Dun should be backed by provincial branches dealing with local problems; facilities for forest education should be improved; and a central forestry board should be formed to decide the quota of timber which each forest unit can produce and of what species these quotas should be made up. Regular working plans for both government and private forests are essential. Management must, however, be adapted to the psychology of the people, the first principle of land utilization being to keep the inhabitants happy and prosperous. Careful consideration should be given to any changes in management which demand changes in the habits and customs of the inhabitants, but obvious abuses must be checked. The formation of recreational areas of jungle for the use of city dwellers is an important part of the programme.

91 (71). COSENS, G. G. **Forest resources and reconstruction in Canada.** *Timber of Canada* 4 (4), 1943 (26–30).

This paper comprises the chapter on forest resources in a book 'Reconstruction in Canada' published recently by the University of Toronto Press. It discusses the opportunities for forest work in Canada after the war, some of the problems involved and various factors that may affect the progress of such work.

91 : 71. STREYFFERT, T. Det allmännas skogspolitik. [**The public forest policy.**] *Norrlands SkogsvFörb. Tidskr.* 1940 (237–51). [Sw.] S.P.S.

The private forest owner tries to obtain the highest possible interest on his capital. If this is invested in more than one branch of production, e.g. forest industry combined with forestry, he is trying to obtain the highest possible interest from the entire undertaking. Similarly, the economic aim of society is to obtain the highest return from its total production. For a given country, the possibilities of forest production are limited. It may be economically justified to use them up to the point corresponding to maximum production of wood provided such a programme means a maximum return from national production, even if, as a result, the interest on the capital invested in forestry is lower than it would be under some other procedure. It is only natural that State forest management should follow a programme that is most favourable from a social point of view. But it is also important to have such a programme accepted in private forestry. This is achieved by appropriate laws, propaganda, and public subsidies towards forest cultivation, forest drainage, etc.

91.1. *Rural Preservation. Reserves. National Parks*

91.1 (47.1). KALLIOLA, R. La protection de la nature en Finlande en prenent tout spécialement les forêts en considération. [**Nature protection in Finland, with special reference to forests.**] *Intersylva* 2, 1942 (517–26). [F.g.e.span.ital.]

Nature protection is based on the law of 1923 and subsequent amendments. In northern Finland there are several large and representative natural reserves and national parks (the latter being open to the public), but only small areas have been protected to date in the southern half of the country. The number of natural monuments (e.g. individual trees of special interest) protected by law is as yet comparatively small. Altogether some 500 forest areas are protected and exempt from all cutting. Encouragement of tourism and nature protection have developed together.

91.4. *Value of the Forest in Hygiene and Recreation*

91.4 (78.6–9 : 79.1–7) : 97.1. WAGAR, J. V. K. **Recreation in relation to multiple land use in the West.** *J. For.* 41, 1943 (798–802). [Colorado State College, Fort Collins, Colo.]

The recreation values of the forest lands of the western states, and the regional problems involved in their retention and development are discussed in this paper.

91.8. *The Forest as a Source of Employment and Income*

91.8 (74.8) : 09.4. FORBES, R. D., and MESAVAGE, C. **The forests of Luzerne County, Pennsylvania, in relation to employment and welfare.** *Anthrac. Surv. Pap. Allegh. For. Exp. Sta.* No. 5, 1943. pp. 21 + map.

92. FOREST LAW

92 (494). BAVIER, B. Richtlinien für eine Revision der schweizerischen Forstgesetzgebung. [**Principles for a revision of Swiss forest legislation.**] *Schweiz. Z. Forstw.* 94, 1943 (11–27). [G.]

Preliminary suggestions elaborated by a commission of the Swiss Forest Society.

92 (73) : 94.3. **Drastic forest regulations in new omnibus bill.** *For. Leaves* 33 (4/5), 1943 (5–7).

An outline of the proposed bill, S. 1330, consisting of ten titles, each of which is in effect a separate bill. The author discusses briefly the first title which is concerned with the public regulation of privately owned forests.

94. FOREST OWNERSHIP

94 (43.1–5) : 23.3. Aufforstung und Waldeigentumsverteilung in den Ostgebieten. [**Afforestation and the distribution of forest ownership in the eastern regions.**] *Forschungsdienst* 15, 1943 (232–3). [G.] A.P.B.

Three types of forests are proposed:—(1) State forests, (2) community forests, and (3) private forests. The State forests are intended to be models of management and will be expected to give a high yield of useful woods. As in northwestern Germany, the community forests will take in a considerable area. Their object will be to strengthen and advance community life among the small populations of villages and country towns for whom forest ownership is of great importance as a means of livelihood and as a source of revenue. Wherever sufficient wooded land is available locally, the community forest will, as a rule, be about 100 to 300 ha. in extent, according to the number of persons in the community. In the interests of production, such corporate forests will be under state control. There

will, however, be no direct state control of private woodlands, as there are other means of ensuring that the production of this type of forest is kept at a comparatively high level. Private forests may only be in the hands of private individuals and may in no case be owned by companies, etc. They will be located only on sites unsuitable for agricultural crops such as corn and sugar beet. The minimum size for private forest property is fixed at 10 ha.

94.12 (47.1). LINNAMIES, O., and RAUTVAUORI, E. **Town community forests in Finland.** *Acta for. fenn.* 50 (2), 1942 (1–71). [Finn.g.] S.P.S.

During the 17th century most of the towns in northern Finland were given forest areas by the State. In recent years many of the towns have increased the size of their forest holdings through purchase and by 1938 the total area of these community forests was 123,752 ha.

94.12 (47.1). RAUTVAUORI, E. **The forests of the market towns of Finland.** *Acta for. fenn.* 50 (4), 1942 (1–49). [Finn.] S.P.S.

Twenty-one of the 27 market towns in Finland have forest areas which total 5,644 ha. This paper reports on the distribution and composition of these forests.

97. POLICY REGARDING THE RELATION OF THE FOREST TO AGRICULTURE, PASTURE, AND INDUSTRY

97.1 (43.1–5). Landwirtschaftliche Zwischennutzung geeigneter Waldflächen. **[Temporary use of suitable wooded areas for agriculture.]** *Forschungsdienst* 15, 1943 (188). [G.] A.P.B.

It is proposed that certain types of forest land should be made available for agricultural use, particularly areas that have been felled and cannot again be turned to wood production during the war. Similar land use has already resulted in increased food production, while plantations of medicinal, ornamental, and oil-bearing plants, in areas where forest trees have been damaged by wind and snow breakage, have in some cases given good results. It is expected that forest officers who are not themselves in a position to undertake agricultural work will direct the people in the neighbourhood to the possibilities of such land use.

97.1 (66.7–9). OLIPHANT, J. N. **Rural development and conservation in West Africa: need for planning service to advise on allocation of land according to its fitness for different uses.** *Repr.* from *Crown Colonist*, Jan. 1944. pp. 3.

An Advisory Committee on Economic Development and Social Welfare has been appointed for Nigeria, with a technical sub-committee, including representatives of the Agricultural, Forest and Veterinary Services, to deal with problems of land utilization.

In this article the author discusses some of the problems involved in the planning and control of land use in West Africa, including uncontrolled burning, shifting cultivation and pasture management, and gives examples of past activities involving the waste or misuse of natural resources.

It is pointed out that the Forest Department has pioneered the movement for land-use planning and control in Nigeria; this is explained partly by the training that forest officers receive in the conservation and use of the natural vegetation, and partly by the realization on the part of foresters that future progress in forest conservation depends on a concerted drive by all rural departments for general conservation. A separate planning service is now needed to carry the work forward. The organization, staff and function of such a service are outlined.

97.1 (79.2) : 34.3. OLSEN, O. A. **Big game in multiple land use in Utah.** *J. For.* 41, 1943 (792–7). [U.S. Forest Service, Ogden, Utah.]

97.2–3 (76.5) : 32.29. WILSON, W. T., and REID, J. W. **Livestock and forestry enterprises on farms in the Ozark region.** *Bull. Ark. agric. Exp. Sta.* No. 419, 1942. pp. 50. A.P.B.

A survey was made of 200 farms in the limestone region of north-central Arkansas where much of the land is of such rough topography that it cannot be used profitably for cultivated crops and where livestock grazing and forestry are the primary bases of farming. The average area of each farm is shown to be 294 acres, of which 156 acres are forested. The farmers consider, on the basis of their own experience, that pasturing livestock is a more profitable enterprise in this area than the growing of timber, and there is thus a tendency to clear additional wooded land for use as pasturage. However, both clearing the land and the subsequent control of sprouts are expensive operations. Heavy grazing by goats for 2 or 3 years has proved to be the most effective method of ridding cleared land of sprouts.

Few farmers have made any attempt to improve their growing timber, and selective cutting has not been practised. Only 8 per cent. of the farmers had sold timber in each of the 5 years from 1933 to 1937; 44 per cent. had sold timber in only one of these years; while 26 per cent. had sold no timber during that period. Livestock provided the principal source of farm income, only 8 per cent. of the total receipts being from timber. In 1937 the timber receipts came principally from lumber (43 per cent.) and stave bolts (27 per cent.).

97.3 : 34.27 : 12.26–8. GIFFORD, J. C. **Shade in southern pastures.** *Proc. 5th Sth. Shade Tree Conf.* 1942 (233–41). [University of Miami, Coral Gables, Florida.]

Shade trees are a valuable asset in cattle pastures especially if they yield good fodder as well as shade. Where the cattle industry is of paramount importance, a compromise appears to be possible between the utilization of forests for timber and for cattle-browsing. Where wood-production is the main purpose of forestry, cattle should, of course, be excluded from wooded areas, but the author recommends that some forests at least should be set aside mainly for the production of fodder and shelter for cattle. More forage is produced by trees than by short, herbaceous crops, and, being perennials, trees do not have to be planted each year. Moreover, as their herbage is produced well above ground it is probably more free from organic contamination than is that of the low-growing vegetation.

Where forests are to be adapted mainly for the use of cattle, with timber production a side-line only, certain species of trees of relatively high forage value, such as Horse-Sugar (*Symplocos tinctoria*), will be given preference. On the other hand, undesirable species, such as Bullhorn Acacia (*Myrmecodendron* sp.) and the Jumbai or Lead tree (*Leucaena glauca*), will naturally be avoided.

97.3 (78) : 97.1 : 60.1 : 34.21. CHAPLINE, W. R. **Multiple use of summer range, and the place of research in range-land conservation.** *J. For.* 41, 1943 (716–21). [U.S. Forest Service, Washington, D.C.]

The relation of grazing to other land-use values is reviewed briefly. While widespread overgrazing of forest lands at one time in the western States did cause considerable damage to trees, research and experience have shown that with proper management the range can be grazed without endangering forest regeneration.

97.3 (87). CRIST, R. E. **Cattle ranching in the tropical rain forest.** *Sci. Mon., Wash.* 56, 1943 (521–7). [Univ. of Puerto Rico.] P.O.

Description of a cattle ranch situated in a region of tropical rain forest southwest of Lake Maracaibo, Venezuela. Experience has shown that it is not only possible to cut down tropical rain forest and keep it under control by planting grasses, but that cattle ranching can be carried on profitably in the tropics provided that transport facilities and a ready market are available.

98. THE TIMBER MARKET

98.1 (71) : 09.4 : 33.0 : 33.32. ARIES, R. S. **Products of Canadian forests.** *Timber of Canada* 4 (1), 1943 (46–59, 148, 150, 152, 154, 156 + dgm.) [Polytechnic Institute, Brooklyn, N.Y.]

A popular illustrated account of the products of Canadian forests, both primary products and those resulting from the chemical utilization of wood. Included is a partial list of uses of forest products as substitutes for steel.

98.1 (728.1) : 12.26–8. **New sources of strategic Balsa wood found in Guatemala.** *J. For.* 41, 1943 (802).

Fairly large quantities of Balsa wood (*Ochroma* spp.) are being obtained from stands growing on abandoned banana plantations and other clearings in Guatemala. As a number of other light woods resembling Balsa are found in that country considerable care is required in selecting and handling the wood.

98.1–2 (66.9) : 33.17. SCOTT, J. D. **The pilot sawmill experiment: a further resumee** [sic] **of its aims and objects.** *Farm and Forest* 4, 1943 (128–9).

Cf. *For. Abstr.* 4 (201). The author discusses briefly the aims in establishing the pilot-sawmill experiment in Nigeria. These are:—

'(1) To try out the markets for cheap sawn timber in finished sizes for building and general utility purposes and ascertain the prices for such material that the average consumer can pay.

'(2) To try out markets for good secondary species of unknown selling value which may supplement those already established in use.

'(3) To obtain accurate figures for direct labour costs in mill operations.

'(4) To train African mill crews for other mills that may be built later'.

98.1–2 (67.1–2). CERMAK, F. Die Möglichkeiten der künftigen Holzversorgung Europas aus den äquatorialen Urwäldern Westafricas. [**The possibilities of the future supply of Europe with wood from the equatorial virgin forests of West Africa.**] *Z. Weltforswirt.* 10, 1943 (3–56). [G.e.f.] [Reichsuniversität, Strassburg.]

The author presents a five-year plan for the post-war exploitation of the forests of Gabon and the Cameroons, including the erection of sawmills and of plants for the manufacture of mechanical pulp.

98.1–3 (4 : 47.1). PÖNTYNEN, V. **The working capacity of the Finnish timber industry in relation to the European continental market.** *Acta for. fenn.* 50 (11), 1942 (1–15). [Finn.g.] S.P.S.

Reference is made to import and export figures for the years 1936 and 1937. The author states that for continental Europe as a whole timber exports are greater than imports, the factor responsible being the large quantities of pulp and paper products that are shipped abroad. Under normal conditions the loss of the British market would mean that Europe had an unusable surplus of timber.

98.2 (66.9). COLLINS, W. B. **War and forest industries.** *Farm and Forest* 4, 1943 (133–5).

A brief discussion of industries in minor forest products that have developed in the Gold Coast during the war period.

98.2 (83). **Chile to develop forest resources.** *B.C. Lumberm.* 27 (10), 1943 (64).

The Government of Chile has set up a National Forests Council for the purpose of studying forest conditions in the country, developing native timbers, and assisting the lumber industry. The composition of the Council is noted and some of its proposed activities and functions are listed.

98.2–4 (77.2) : 12.26–8 : 76.2 : 32.81. BRUNDAGE, R. C. **Marketing timber in the north central area of Indiana.** *Bull. Purdue Univ. agric. Exp. Sta.* No. 477, 1942. pp. 28.

The bulletin is written mainly for farmers, and deals with local timber markets, recent trends in the demand for, and price of, timber, and timber marketing methods.

98.2 (94). GREGSON, F. **Wartime timber industry. Proposals for stimulating production.** *Aust. For.* 7, 1943 (38–47).

While the demand for timber in Australia is being maintained, there has been almost complete cessation of imports, which made up about 40 per cent. of the supplies prior to the war, and, in addition, the timber industry has lost a large number of men to the forces. It is therefore necessary to consider every means possible for increasing production per man. In this paper a scheme is presented for increasing individual production, with particular reference to the position in Western Australia. The scheme is based on a State production objective of 125 million super. ft. sawn per annum; in general it aims at assessing the performance of individual mills, reporting this information to a correlating centre, and sending the comparable data back to the mills for publicity purposes, thus giving the management and employees an incentive to improve performance.

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